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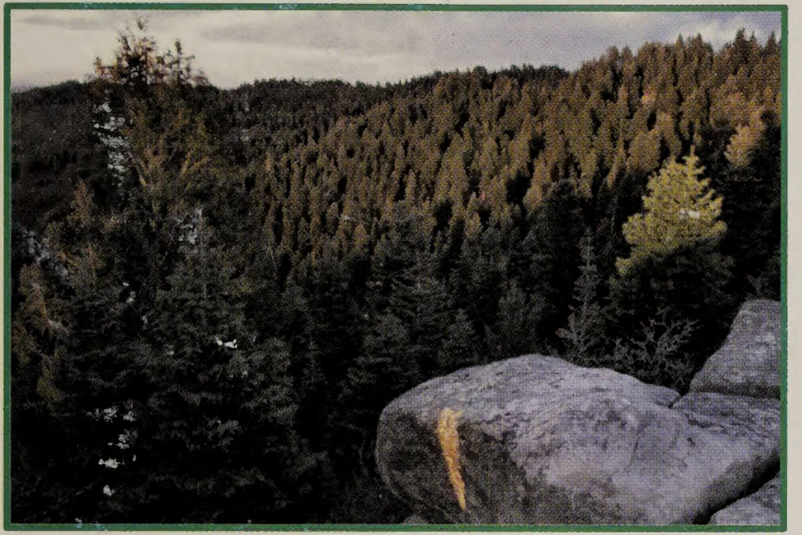
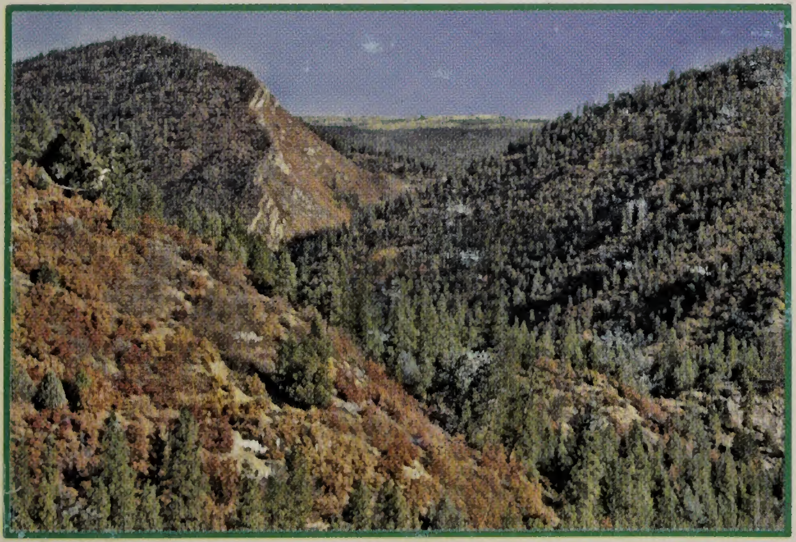
# Draft Environmental Impact Statement

## Northern San Juan Basin Coal Bed Methane Project
## Volume I





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June 2004

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Dear Reader:

We have just completed a Draft Environmental Impact Statement (DEIS) documenting our environmental analysis of the Northern San Juan Basin Coal Bed Methane project. We are sending a copy so you may review it. The DEIS analyzes several companies' proposal to develop 300 wells and ancillary facilities within a 125,000-acre study area. Their proposal is depicted as Alternative 1 in the DEIS.

Many key concerns or issues were identified based on the possible environmental effects of Alternative 1. Some of these include, for example: loss of roadless area character, loss of different types of wildlife habitat and old growth habitat, changes in water quality and quantity, and changes in air quality. We have attempted to address these issues by developing a range of alternatives and proposing mitigation and monitoring measures. We are particularly interested in your ideas on the air mitigation measures we have developed, and on the proposed change in travel management we have described in the recreation and wildlife sections.

Alternative 1A is the Agency Preferred Alternative. This alternative attempts to reduce some of the physical impacts of CBM gas development and the number of facilities needed to develop the CBM gas resource. Two of the suggested mitigation strategies are to utilize well locations that avoid the most sensitive resources and to use directional drilling technologies.

You may view the DEIS on the Northern San Juan Basin EIS web site at http://www.nsjb-eis.org. Copies of the DEIS also are available for public inspection at the following offices:

U.S. Forest Service and Bureau of Land Management
San Juan Public Lands Center
15 Burnett Court
Durango, Colorado 81301

Columbine Ranger District
367 Pearl Street
Bayfield Colorado 81122

We recommend that you begin by reading the Preface of the DEIS, which will orient you to the document.

We will accept comments on this DEIS for 90 days after the date the Environmental Protection Agency publishes its Notice of Availability in the *Federal Register*. The agencies will notify all parties on the project mailing list of the dates when comments will be accepted. During this time, you are encouraged to submit written comments.

ITEM HAS BEEN DIGITIZED

During the comment period, we will hold public meetings and other public involvement activities. We will notify you in advance of these opportunities through public notices, news media releases, the FS web page (http://www.fs.fed.us/r2/sanjuan/) and the project's homepage (www.nsjb-eis.org).

In the FEIS, the agencies will respond to all substantive comments submitted on the DEIS. The comment period will provide you with an opportunity to make an impact on the content of the document and, therefore, potentially affect the decision that will be made after release of the FEIS. We ask that your comments relate directly to the DEIS, that you are as specific as possible, and that you cite the location or locations in the document on which you are commenting. To be addressed, comments must: relate to inadequacies or inaccuracies in the analysis or methodologies; identify new impacts or recommend reasonable new alternatives or mitigation measures; involve substantive disagreements or interpretations of significance; or request assessment clarifications that bear on conclusions.

Please retain this copy of the DEIS for future reference because the FEIS may be published in abbreviated format. If you have any questions or require additional copies of this document, please call Walt Brown or Jim Powers at (970) 385-1304. We appreciate your interest in public land management.

Comments on the DEIS should be sent to:

Postal mail: Northern San Juan Basin CBM EIS
USDA FS Content Analysis Team
PO Box 221150
Salt Lake City, UT 84122

email: nbasin-cbm-eis@fs.fed.us

I have some difficult choices to make with this project and there are no easy answers. This DEIS lays out the best information and ideas that we have been able to come up with so far on how to address the concerns and issues resulting from this project. I hope that after you review this document that you can provide further ideas on how these alternatives and mitigation and monitoring measures might be improved while still addressing leaseholder rights. We look forward to your thoughtful review and input.

Sincerely,

Mark W. Stiles
Forest Supervisor/Center Manager

# Draft Environmental Impact Statement
# Northern San Juan Basin Coal Bed Methane Project
# La Plata and Archuleta Counties

| | |
|---|---|
| Lead Agencies: | U.S. Forest Service and Bureau of Land Management<br>San Juan Public Lands Center<br>15 Burnett Court<br>Durango, Colorado 81301 |
| For Further Information, Contact: | Jim Powers or Walt Brown<br>San Juan Public Lands Center<br>15 Burnett Court<br>Durango, Colorado 81301 |

## Abstract

Six companies have proposed to drill approximately 300 new CBM wells within the Project Area. The companies would also construct the ancillary facilities needed to support these wells. These facilities include access roads; pipelines for gathering gas and produced water; electric facilities; facilities for measuring and compressing gas; and facilities for treating, containing, and disposing of produced water using deep underground injection. The companies' proposal includes directional drilling to avoid steep slopes in portions of the HD Mountains, where feasible.

The overall life of the project, including construction, production, and reclamation, would be approximately 40 years. Construction of wells would begin during 2005 and would continue for 5 years. The productive life of each well is expected to be about 25 to 30 years. Accordingly, production from the wells drilled at the end of the 5-year drilling period is expected to conclude by 2040. This environmental analysis of the companies' proposal to develop the gas field focuses on a 125,000-acre Project Area in the Northern San Juan Basin of Colorado. The Project Area occupies portions of La Plata and Archuleta Counties.

Seven alternatives are analyzed in detail. Thematically they represent the Companies' Proposed Action (Alternative 1), BLM and Forest Service modifications of the Proposed Action (Alternatives 1A thru 4), and the No Action Alternative (Alternative 5). Each of the alternatives considers the federal action, which is development of federal oil and gas leases within the Project Area, and development on all jurisdictions, including private and state leases within the Project Area.

Alternatives 1A and 1B are sub-alternatives that implement the Proposed Action, but do so by including directional and horizontal drilling methods to reduce the Proposed Action's surface impacts. Actions under these two alternatives would include siting multiple wells on some well pads. These wells would drain the same lease areas as the wells under Alternative 1.

The Forest Supervisor/Center Manager (Mark Stiles) is the Authorized Officer responsible for preparing this Draft Environmental Impact Statement.

ITEM HAS BEEN DIGITIZED

# Preface

This Environmental Impact Statement (EIS) follows the format established in the National Environmental Policy Act's regulations (Title 40 Code of Federal Regulations Parts 1500 to 1508). The following is an outline of information contained in the chapters and appendices so readers may find the areas of interest without having to scan the entire document.

- *Chapter 1 — Purpose and Need,* identifies and describes the purpose of and need for the proposed action, the history of oil and gas development in the Northern San Juan Basin, decisions to be made by the agencies, their roles and responsibilities, the National Environmental Policy Act (NEPA) process, and other permits required. This chapter also describes the processes for public participation and issue identification.

- *Chapter 2 — Proposed Action and Alternatives* describes the proposed action and the significant or key issues associated with the proposed action, and alternatives, including the no action alternative. The agencies developed action alternatives that meet the purpose of and need for the project in response to one or more of the key issues. Alternatives considered but eliminated from detailed consideration are identified, along with the rationale for excluding them from the analysis. This chapter also provides a comparative analysis of the environmental effects of the primary alternatives to provide a clear basis of choice among options for the decision maker and the public. The lead agency's preferred alternative is identified.

- *Chapter 3 — Affected Environment and Environmental Consequences* scribes the present condition of the environment that would be affected by implementation of the proposed action or any action alternative. The Environmental Consequences describes the probable and cumulative effects to the human environment that would result from implementing the proposed action or alternatives. The discussion also addresses unavoidable impacts, and irreversible or irretrievable impacts. Activities that contribute to cumulative effects that are reasonably foreseeable are also identified and analyzed in concert with the alternatives.

- *Chapter 4 — Consultation with Others*: identifies the agencies, companies, and organizations consulted, as well as the cooperating agencies.

- *Chapter 5— Preparers and Contributors*: identifies the staff involved in draft EIS preparation.

- *Chapter 6 — Distribution of the Draft EIS*: identifies the persons, organizations, businesses, and agencies that received the draft EIS.

- *Chapter 7 — Glossary*: describes the technical terms used in the draft EIS.
- *Chapter 8 — References Cited*: lists the references cited in the draft EIS.
- *Appendices*: contain technical and non-technical information that is important to full comprehension of the NEPA analysis but that was too long to be included in the primary chapters.

## Acronyms and Abbreviations used in this EIS

| | |
|---|---|
| °C | Degrees Celsius |
| °F | Degrees Fahrenheit |
| µeq/L | Milliequivalents per liter |
| µg/L | Micrograms per liter |
| µg/m$^3$ | Micrograms per cubic meter |
| µhmos/cm | Micromhos per centimeter |
| µS/cm | microSiemens per centimeter |
| AADT | Annual Average Daily Traffic |
| ACEC | Area of Critical Environmental Concern |
| ACHP | Advisory Council on Historic Preservation |
| ADT | Average Daily Traffic |
| AIRFA | American Indian Religious Freedom Act |
| AMLI | Abandoned Mine Lands Initiative |
| ANC | Acid Neutralizing Capacity |
| APD | Application for Permit to Drill |
| APE | Area of Potential Effect |
| API | American Petroleum Institute |
| APLIC | Avian Power Line Interaction Committee |
| AQD | Air Quality Division |
| AQRV | Air Quality Related Values |
| ASME | American Society of Mechanical Engineers |
| ATV | All-terrain Vehicle |
| AUM | Animal Unit Month |
| BA | Biological Assessment |
| BACT | Best Available Control Technology |
| Bbl | Barrel |
| BBS | Breeding Bird Survey |
| bcf | Billion Cubic Feet |
| BE | Biological Evaluation |
| BLM | U.S. Department of Interior, Bureau of Land Management |
| BMP | Best Management Practices |
| BOE | Barrels of Oil Equivalent |
| BOPE | Blowout Prevention Equipment |
| BOR | U.S. Bureau of Reclamation |
| CAA | Clean Air Act |
| CAAQS | Colorado Ambient Air Quality Standards |
| CALMET | California Meteorological Model |
| CALPUFF | California Puff atmospheric dispersion model |
| CAPS | Cooperative Agricultural Pest Survey |
| CBM | Coal Bed Methane |
| CDNR | Colorado Department of Natural Resources |
| CDOT | Colorado Department of Transportation |
| CDOW | Colorado Division of Wildlife |
| CDPHE | Colorado Department of Public Health and Environment |
| CDPHE-APCD | Colorado Department of Public Health and Environment, Air Pollution Control Division |
| CDWR | Colorado Department of Water Resources |
| CEQ | Council on Environmental Quality |

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|---|---|
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| cfs | Cubic feet per second |
| CGS | Colorado Geological Survey |
| CIR | County Impact Report |
| CO | Carbon Monoxide |
| COA | Conditions of Approval |
| COE | U.S. Army Corps of Engineers (also USACE) |
| COGCC | Colorado Oil and Gas Conservation Commission |
| CR | County Road |
| CRAA | Chimney Rock Archaeological Area |
| CREG | Consensus Revenue Estimating Group |
| CRMP | Coordinated Resource Management Plan |
| CRS | Colorado Revised Statutes |
| CRU | Critical Range Unit |
| CSU | Controlled Surface Use |
| CVU | Common Vegetation Unit |
| CWA | Clean Water Act |
| dBA | Decibels on the A-weighted Scale |
| DBH | Diameter at Breast Height |
| DEIS | Draft Environmental Impact Statement |
| DNA | Documentation of NEPA Adequacy |
| dV | Deciview |
| DWS | Drinking Water Standard |
| E&P | Exploration and Production |
| EA | Environmental Assessment |
| EC | Electrical Conductivity |
| ECw | SAR and Salinity Limit |
| EIS | Environmental Impact Statement |
| EPA | U.S. Environmental Protection Agency |
| ESA | Endangered Species Act |
| ET | Evaportranspiration |
| FAR | Federal Aviation Regulations |
| FCSMA | Fortification Creek Special Management Agency |
| FEIS | Final Environmental Impact Statement |
| FERC | Federal Energy Regulatory Commission |
| FIRE | Finance, Insurance, and Real Estate |
| FLAG | Federal Land Managers' Air Quality Related Values Workgroup |
| FLPMA | Federal Land Policy and Management Act |
| FS | U.S. Department of Agriculture, Forest Service |
| FSH | Forest Service Handbook |
| g/HP-hour | grams per horsepower-hour |
| GIS | Geographic Information System |
| GMWL | Global Meteoric Water Line |
| gpm | Gallons per minute |
| $H_2S$ | Hydrogen Sulfide |
| HAP | Hazardous Air Pollutant |
| HP | Horsepower |
| HSS | Habitat Structural Stages |

| | |
|---|---|
| HUC | Hydrologic Unit Code |
| in/hr | Inches per hour |
| ISCST | Industrial Source Complex — Short Term Atmospheric Dispersion Model |
| ISL | In Situ Leach |
| kg/ha-year | Kilograms per hectare-year |
| KGS | Known Geologic Structure |
| kV | Kilovolt |
| kWh | Kilowatt hour |
| LAC | Level of Acceptable Change |
| LN | Lease Notice |
| LOP | Life of Project |
| LOS | Level of Service |
| LPEA | La Plata Electric Association |
| LRMP | Land and Resource Management Plan |
| LRPL | Least Restrictive Proposed Limit |
| MACT | Maximum Achievable Control Technology |
| MBbl | Thousand Barrels |
| MBTA | Migratory Bird Treaty Act |
| mcdf | Thousand cubic feet per day |
| mcf | Thousand cubic feet |
| MEI | Maximum Exposed Individual |
| mg/L | Milligrams per liter |
| mgd | Million gallons per day |
| $mi/mi^2$ | Miles per square mile |
| MIS | Management Indicator Species |
| MLA | Mineral Leasing Act |
| MLE | Most Likely Exposure |
| MM4 | Pennsylvania State University/National Center for Atmospheric Research Mesoscale Model Version 4 |
| mmcf | Million cubic feet |
| mmcfd | Million cubic feet per day |
| mmhos/cm | Microhmos per centimeter |
| MMRP | Mitigation, Monitoring, and Reporting Plan |
| MOC | Memorandum of Cooperation |
| MRL | Minimum Reporting Level |
| MRPL | Most Restrictive Proposed (Upper) Limit |
| msl | Mean Sea Level |
| MSO | Mexican Spotted Owl |
| MW | Megawatt |
| NAAQS | National Ambient Air Quality Standards |
| NAGPRA | Native American Graves Protection and Repatriation Act |
| NEPA | National Environmental Policy Act |
| NFS | National Forest System |
| NFSR | National Forest System Road |
| NHPA | National Historic Preservation Act |
| NISC | National Invasive Species Council |
| NL | No Lease |
| NMP | National Memorial Park |
| $NO_2$ | Nitrogen Dioxide |
| NOAA | National Oceanic and Atmospheric Administration |

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| NOI | Notice of Intent |
| NOS | Notice of Staking |
| $NO_x$ | Oxides of Nitrogen |
| NPDES | National Pollutant Discharge Elimination System |
| NPS | National Park Service |
| NRCS | Natural Resources Conservation Service |
| NRHP | National Register of Historic Places |
| NSA | Noise Sensitive Area |
| NSJB | Northern San Juan Basin |
| NSO | No Surface Occupancy |
| NSR | New Source Review |
| NTL | Notice to Lessees |
| NWI | National Wetlands Inventory |
| OAHP | Office of Archaeology and Historic Preservation |
| OHV | Off-highway Vehicle |
| ORV | Off-road Vehicle |
| OSHA | Occupational Safety and Health Administration |
| P.L. | Public Law |
| PAH | Polycyclic Aromatic Hydrocarbon |
| PAR | Parturition Areas (Habitat) |
| PFYC | Probable Fossil Yield Classification |
| $PM_{10}$ | Inhalable Particulate Matter Less than 10 Microns in Effective Diameter |
| $PM_{2.5}$ | Fine Particulate Matter Less than 2.5 Microns in Effective Diameter |
| POD | Plan of Development |
| ppm | Parts per Million |
| PA | Programmatic Agreement |
| PSD | Prevention of Significant Deterioration |
| psi | Pounds per Square Inch |
| R&PP | Recreation and Public Purpose |
| RA | Recreation Area |
| RACR | Roadless Area Conservation Rule |
| RCRA | Resource Conservation and Recovery Act |
| RFD | Reasonably Foreseeable Development |
| RFFA | Reasonable Foreseeable Future Actions |
| RMP | Resource Management Plan |
| RMU | Resource Management Unit |
| RNA | Research Natural Area |
| ROD | Record of Decision |
| ROS | Recreational Opportunity Spectrum |
| ROW | Right of Way |
| RUSLE | Revised Universal Soil Loss Equation |
| RV | Recreational Vehicle |
| S&G | Standards and Guidelines |
| SAR | Sodium Adsorption Ratio |
| SARA | Superfund Amendments and Reauthorization Act |
| SCORP | Statewide Comprehensive Outdoor Recreation Plan |
| SCS | Soil Conservation Service |
| SDDENR | South Dakota Department of Environment and Natural Resources |

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| SDWA | Safe Drinking Water Act |
| SEO | State Engineer's Office |
| SH | State Highway |
| SHPO | State Historic Preservation Office |
| SHT | Self-heating Temperature |
| SIO | Scenic Integrity Objectives |
| SJB | San Juan Basin |
| SJFO | San Juan Field Office |
| SJNF | San Juan National Forest |
| SJPLC | San Juan Public Lands Center |
| SLT | Standard Lease Terms |
| SMA | Special Management Area *or* Surface Management Agency |
| $SO_2$ | Sulfur Dioxide |
| SPCC | Spill Prevention Control and Countermeasures |
| SSC | Species of Special Concern |
| SSF | Spring-Summer-Fall (Habitat) |
| STIP | Surface Transportation Improvement Plan |
| SUIR | Southern Ute Indian Reservation |
| SUIT | Southern Ute Indian Tribe |
| SUP | Special Use Permit |
| SUPO | Surface Use Plan of Operations |
| SWMP | Stormwater Management Plan |
| SWPPP | Storm Water Pollution Prevention Plan |
| SWQATR | Surface Water Quality Analysis Technical Report |
| SWR | Severe Winter Relief (Habitat) |
| SWWF | Southwestern Willow Flycatcher |
| tcf | Trillion Cubic Feet |
| TCP | Traditional Cultural Properties |
| TCU | Transportation, Communication, and Utilities |
| TDS | Total Dissolved Solids |
| TIE | Toxicity Identification Evaluation |
| TL | Timing Limitation |
| TMDL | Total Maximum Daily Load |
| TSI | Transportation System Inventory |
| TSS | Total Suspended Solids |
| TU | Tritium Units |
| UIC | Underground Injection Control |
| UNM | University of New Mexico |
| USC | United States Code |
| USDA | U.S. Department of Agriculture |
| USDC | U.S. Department of Commerce |
| USDI | U.S. Department of the Interior |
| USDOT | U.S. Department of Transportation |
| USDW | Underground Sources of Drinking Water |
| USFWS | U.S. Department of Interior, Fish and Wildlife Service |
| USGS | U.S. Department of the Interior, Geological Survey |
| VMS | Visual Management System |
| VMT | Vehicle Miles Traveled |
| VOC | Volatile Organic Compound |
| VQO | Visual Quality Objective |
| VRM | Visual Resource Management |

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| W&P | Weed and Pest |
| WHMA | Wildlife Habitat Management Area |
| WIA | Walk-in Area |
| WIN | Winter (Habitat) |
| WIZ | Watershed Influence Zones |
| WRCC | Western Regional Climate Center |
| WSA | Wild and Scenic Area *or* Wilderness Study Area |
| WSR | Wild and Scenic River |
| WWTP | Wastewater Treatment Plant |
| WYL | Winter-Yearlong (Habitat) |
| ybp | Years before present |
| YRL | Yearlong (Habitat) |

# Executive Summary

## Chapter 1 — Purpose and Need for the Proposed Action

### Introduction

HEC Petroleum, XTO Energy, Petrox Resources, Elmridge Resources, Exok, and BP America ("the companies") propose to drill approximately 300 wells to produce natural gas from coal beds on Federal, State, and privately owned lands in La Plata and Archuleta Counties, Colorado. The companies would also construct ancillary facilities needed to support the wells. The companies' proposal includes directional well drilling to avoid steep slopes in portions of the HD Mountains, where feasible.

### Purpose and Need

Private industry exploration and development of federal oil and gas leases is an integral part of the BLM's oil and gas leasing program under the authority of the Mineral Leasing Act of 1920, as amended, the Mining and Mineral Policy Act of 1970, the Federal Land Policy and Management Act of 1976, the National Materials and Minerals Policy, Research, and Development Act of 1980, and the Federal Onshore Oil and Gas Leasing Reform Act of 1987.

The purpose and need for this project is to allow the companies to drill to develop their federal oil and gas leases and to help meet the public's need for natural gas by increasing the number of wells that produce coal bed methane (CBM). The proposed CBM development would exercise the leaseholders' existing rights to drill for, extract, remove, and market gas products. National mineral leasing policies and the regulations by which they are enforced recognize the statutory right of lease holders to develop federal mineral resources to meet continuing needs and economic demands so long as undue and unnecessary environmental degradation is not incurred. Also included is the right of the leaseholder within the project area to build and maintain necessary improvements, subject to renewal or extension of the leases in accordance with the proper authority.

This project would serve to meet the goals for management of energy minerals set forth in the Land and Resource Management Plan (LRMP) for the San Juan National Forest (FS 1983) and in the Resource Management Plan (RMP) for the San Juan/San Miguel Planning Area (BLM 1984).

## Project Area

This environmental analysis of the companies' gas field development proposal focuses on a 125,000-acre Project Area in the Northern San Juan Basin (NSJB) of Colorado. The Project Area is that portion of the San Juan Basin north of the boundary of the Southern Ute Reservation, bounded on the south by the reservation and to the west, north, and east by the arcing line of the outcrop at the top of the Fruitland Formation.

The Project Area consists of 7,000 acres of Bureau of Land Management (BLM) administered land; 49,000 acres of U.S. Forest Service (FS) administered land, 9,000 acres of private lands with federal minerals, and 60,000 acres of state or privately held (fee) lands with non-federal minerals. The Project Area occupies portions of La Plata and Archuleta Counties.

## Scope of Agency Decisions

This environmental impact statement (EIS) and its supporting project record are the basis for the Record of Decision (ROD) that will document the following BLM and FS decisions:

(1) Overall plan and conditions of development, including environmental protection measures that apply to the entire Project Area, or to portions of the area.

(2) Conditions under which ancillary facilities requested by the proponent may be constructed (water and gas flowlines and compressor stations on National Forest System [NFS] or BLM lands).

(3) Conditions of approval specific to the 56 pending SUPOs and applications for permit to drill (APDs) submitted by the companies.

(4) Whether to waive, allow an exception for, or modify the no surface occupancy stipulations issued May 14, 2001, on five leases within the Project Area, COC64932, COC64933, COC64934, COC64935, COC64936.

(5) Whether to continue or to terminate in whole or in part the Interim Criteria for development within the Project Area as described in Notice to Lessees (NTL) No. CO-SJFC-2000-01.

These decisions will incorporate the terms and mitigation requirements that the agencies deem necessary to protect the surface and sub-surface resources based on disclosure of environmental effects in this EIS for CBM field development.

Project decisions will be documented in a ROD signed by the BLM and FS responsible officials and will apply to federal mineral estate only. The private mineral estate is under the administrative jurisdiction of the Colorado Oil and Gas Conservation Commission (COGCC) and is not subject to the decisions documented in the ROD for this proposal. Decisions by other jurisdictions to issue (or not to issue) approvals on to this proposal may be aided by the disclosure of impacts that is available in this analysis.

# Chapter 2 — Alternatives

The alternatives were designed to respond to management concerns and issues identified through scoping. Seven alternatives are analyzed in detail. Thematically they represent the Proposed Action (Alternative 1), BLM and FS modifications of the Proposed Action (Alternatives 1A thru 4), and the No Action Alternative (Alternative 5). Each of the alternatives considers the federal action, which is development of federal oil and gas leases within the Project Area, and development on all jurisdictions, including private and state leases within the Project Area. The No-Action alternative is required under 40 CFR 1502.14.

## Alternative 1 — Proposed Action

Alternative 1 is the companies CBM development proposal. The federal action that would be the subject of federal decision-making under Alternative 1 would be to allow environmentally sound drilling of and subsequent production from 197 wells located on 174 well pads on federal oil and gas leases in the Project Area.

Comprehensively, Alternative 1 includes the companies drilling 296 new CBM wells on 273 well pads on all jurisdictions within the Project Area and constructing the ancillary facilities needed to support these wells. These facilities include access roads; pipelines for gathering gas and produced water; electric facilities; facilities for measuring and compressing gas; and facilities for treating, containing, and disposing of produced water using deep underground injection or possibly surface discharge.

The companies propose to directionally drill 25 wells in the high elevation portion of the HD Mountains. Well pads for directional drilling are larger than well pads for single vertical wells. The 15 multi-well pads that would be needed for directional wells under Alternative 1 are located in the eastern half of T34N, R6W.

The companies would also construct an estimated 100 miles of collocated access roads and gathering lines, up to seven disposal wells, 14 compressors units on 11 new sites, and approximately 17 miles of gas trunk line within the Project Area. Trunk lines transport gas from the compressors to the transmission pipelines.

The overall life of the project, including construction, production, and reclamation, is approximately 40 years. Well construction would begin during 2004 and would continue for 5 years. The productive life of each well is expected to be about 25 to 30 years. Accordingly, production from the wells drilled at the end of the 5-year drilling period would conclude by 2039. Final reclamation of each well would take place during the 2 to 3 years immediately after the end of its productive life. Thus, the project would be completed by the end of 2042.

## Alternative 1A — Agency Preferred Alternative

Alternative 1A modifies the proposed action to mitigate and/or reduce direct surface impacts through well siting measures that consolidate facilities to reduce surface well density in certain portions of the planning area. Specifically, it is estimated that 62 well pads and their associated 24 miles of road would be eliminated. This would require drilling operations to be consolidated onto fewer well pads based upon site-specific considerations, technically feasibility, and consistency with the lease rights granted. The federal action would involve permitting activities to allow the companies to develop 184 wells from 112 well pads on federal mineral estate.

Within the Project Area, a total of 283 wells would be drilled from 211 well pads on all jurisdictions. Thus, access to the reservoir from some of the identified Federal well pads would be through directional drilling, which by definition includes a variety of different well bore configurations including horizontal wells. This alternative was designed to provide a surface location (drill site) that is no more than 1,800 feet horizontally from the permitted bottom hole location in the reservoir.

Limiting this horizontal distance to 1,800 feet was predicated upon a number of factors including depth to the reservoir, reservoir and rock properties, and the technical and economic feasibility of various directional-drilling techniques.

## Alternative 1B

Alternative 1B modifies the proposed action to significantly reduce surface impact through well siting measures that consolidate facilities to reduce surface well density through certain portions of the planning area. Specifically it is estimated that Alternative 1B would eliminate 115 well pads and 56 miles of road from the Proposed Action. This would require drilling operations to be consolidated onto identified well pads based upon site-specific considerations, technical feasibility, and consistency with the granted lease rights. The federal action involves permitting the drilling of 135 horizontal well legs from 62 well pad locations.

Comprehensively, Alternative 1B includes a total of 231 wells on 158 well pads on all jurisdictions within the Project Area. Thus, access to the reservoir from some of the identified Federal well pads would be through directional drilling, which by definition includes a variety of different well bore configurations including horizontal wells. The estimated horizontal distance from well pad to the permitted bottom hole location in the reservoir is approximately 3,600 feet. Based upon recent drilling tests in La Plata County which have similar horizontal offset distances, long reach horizontal drilling would be required since other directional drilling well bore configurations are not technically, or economically feasible due to the relatively shallow depth of the reservoir.

Long-reach horizontal drilling entails constructing a single well pad of approximately 4 acres that would be used to drill up to four individual single bore, long-reach wells. On average, each well pad provides a surface location for drilling and development of the reservoir for an area of 1,280 acres.

Long-reach horizontal drilling would be used across the relatively undeveloped portions of the HD Mountains, where impacts would be mitigated through consolidation of drilling operations onto identified well pads. The locations of the well pads are dictated by constraints on road access and by the objective of promoting optimal reservoir management.

## Alternative 2

Alternative 2 is developed specifically to address the assumption that the demand and price for natural gas would significantly increase in the future, triggering further development of CBM. As such, the alternative is based on the assumption that the companies would seek to develop wells to a density of four per section throughout most of the entire Project Area. Alternative 2 differs from Alternative 1 only in scale. Thus, the following description focuses on aspects of Alternative 2 that differ from Alternative 1.

The federal action that is the subject of federal decision-making under Alternative 2 would be to allow environmentally sound drilling of and subsequent production from 317 wells on 294 well pads on federal oil and gas leases in the Project Area.

Comprehensively, Alternative 2 includes the companies drilling 522 CBM wells on 499 well pads and about 203 miles of collocated access roads and pipelines on all jurisdictions in the Project Area. In addition, the companies would construct up to seven additional disposal wells and would install 15 new compressor sites.

## Alternative 3

Alternative 3 is a modification of the Proposed Action (Alternative 1) that reduces the number of wells in the HD Mountains Inventoried Roadless Area. Alternative 3 is considered in detail to address concerns about the impacts of CBM development on the HD Mountains Inventoried Roadless Area.

The federal action that is the subject of federal decision-making under Alternative 3 would be to allow environmentally sound drilling of and subsequent production from 113 wells on federal oil and gas leases in the Project Area.

Comprehensively, Alternative 3 includes the drilling of 212 CBM wells on 212 well pads, and constructing 78 miles of collocated access roads and pipelines and 10 miles of trunk line on all jurisdictions in the Project Area. The Alternative also would include up to four disposal wells and 10 new compressor stations.

## Alternative 4

Alternative 4 modifies the Proposed Action (Alternative 1) by allowing for development of federal leases in accordance with the plan developed for the HD Mountains in 1992 and other BLM and FS plans, policy documents, and orders that currently guide development of CBM gas in the Project Area. These instruments include (1) the 1992 USFS HD Mountains CBM Gas Field Development Project FEIS, (2) the 1991 BLM San Juan/San Miguel Resource Management Plan Amendment, (3) the Interim Criteria for Fruitland CBM Development set forth in NTL No. CO-SJFO-2001-01 (2000), and (4) the conditional no surface occupancy stipulations imposed on five oil and gas leases. The assumptions for development of federal oil and gas leases under this alternative are as follows:

The federal action that would be the subject of federal decision-making under Alternative 4 would be to allow environmentally sound drilling of and subsequent production from 84 wells on federal oil and gas leases encompassing BLM lands and the HD Mountains.

The number of wells on private and state lands in the western portion of the Project Area is assumed the same as the Proposed Action (Alternative 1).

Comprehensively, Alternative 4 includes a total of 185 CBM wells on 185 well pads on all jurisdictions within the Project Area. The companies would construct about 91 miles of collocated access roads and pipelines and 10 miles of trunk line within the Project Area. Up to two disposal wells and six compressor stations would also be constructed.

## Alternative 5 — No Action

Under the "No Action" alternative, the BLM and FS would not approve the proposed CBM operations on the Federal leases in the Project Area at this time. However, drilling would continue on private and state leases, and BLM and FS would grant access across federal lands where other reasonable routes are not available to reach proposed well sites on state and fee lands.

The companies would drill an additional 117 wells on non-federal leases, thus reaching a density of four wells per section throughout much of the western and central sections of the Project Area. State and fee leases are under the regulatory jurisdiction of COGCC and not the federal agencies. The companies would also construct 40 miles of collocated access roads and pipelines, five compressor stations, and 10 miles of trunk line within the Project Area.

The No Action Alternative does not meet the purpose and need for the proposed action, nor does it support minerals management policies of the BLM and FS. However, NEPA procedural regulations require that federal agencies evaluate in detail a "No Action" alternative that provides a baseline for comparing and measuring the effects of a proposed action and other "action" alternatives.

# Chapter 3 — Affected Environment and Environmental Consequences

The affected environment is briefly described and includes the physical, biological, social, and economic resources that the alternatives may impact.

**Table 1 Comparative Summary of Alternatives Considered in Detail**

| Parameter | Existing | Alternative<br>1 | 1A | 1B | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|
| CBM Wells (number) | 276 | 296 | 283 | 231 | 522 | 212 | 185 | 118 |
| CBM Well Pads (number) | 276 | 273 | 211 | 158 | 499 | 212 | 185 | 118 |
| Short-Term Disturbance (acres) | NA | 1,113 | 965 | 690 | 1,843 | 756 | 766 | 422 |
| Long-term Disturbance (acres) | NA | 684 | 630 | 484 | 1,171 | 474 | 478 | 253 |
| Roads/Pipelines (total length in miles) | 191 | 118 | 94 | 62 | 203 | 78 | 91 | 40 |
| Gathering Pipelines (total length in miles) | 0 | 4 | 5 | 0 | 4 | 1 | 0 | 0 |
| Produced Water Disposal Wells (number) | 6 | 7 | 6 | 7 | 7 | 4 | 2 | 0 |
| Compressor Stations (number)[1] | 6 | 14 | 14 | 7 | 15 | 10 | 6 | 5 |
| Automated Central Gathering Station | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 |
| Total Compressor Horsepower | 24,400 | 42,500 | 42,500 | 42,500 | 47,500 | 34,640 | 31,240 | 13,740 |
| Compression Station Trunk Pipelines (Total length in miles) | 5 | 17 | 17 | 17 | 17 | 10 | 10 | 10 |

Note:
1. Number of compressor stations resulting in new surface disturbance.

The environmental consequences summarized in this section focus on the most important impacts of Alternative 1A — the BLM and Forest Service preferred CBM development alternative. "Preferred" means Alternative 1A represents the alternative the BLM and Forest Service would likely select in their respective RODs following issuance of the final environmental impact statement. Chapter 2, Table 2–27 describes and contrasts the environmental consequences of each of the alternatives evaluated in detail in summary form.

## Methane Seeps

Concerns related to methane seepage at the Fruitland Formation outcrop include: the potential for seeps to impact groundwater aquifers and surface water resources; human health and safety concerns; potential for seeps to impact vegetation and soils; potential for hydrogen sulfide seeps; and potential for propagation of greenhouse gasses. Findings include:

- Groundwater resources along the Fruitland outcrop are affected by CBM development and would continue to be affected beyond the life of the project. With CBM development expanding eastward into Archuleta County, groundwater resources on the Fruitland Formation outcrop in Archuleta County would be affected by increased methane seepage. Further CBM development would increase the areas of the Fruitland outcrop that are affected by active methane seepage. Thus, the number of shallow domestic wells, seeps, and springs affected by methane seepage would increase. Any number of the 20 water wells on the Fruitland Formation outcrop may be affected by increased methane concentrations.

- Surface water affected by CBM development is limited to small springs emanating from the Fruitland Formation and the Pictured Cliffs Sandstone. Larger bodies of surface water (Texas Creek; the Animas, Pine, and Florida Rivers) are already subject to methane seepage from naturally occurring methane seeps and from the current CBM well field. These seeps are not predicted to increase in overall rate. Therefore, methane seepage from additional CBM development would not further impact these surface water bodies. Squaw Creek, at Yellowjacket Pass, may experience increased methane seepage, and other unnamed springs along the eastern portion of the outcrop may additionally be affected by methane seepage, as may the Piedra River.

- There are no observable effects on water quality or aquatic life at the existing pre-CBM methane seeps in the Animas, Pine, and Florida Rivers. Increased methane seepage to surface water bodies is not expected to affect other resources and would negligibly affect surface water chemistry.

- Current methane seepage has affected an estimated 300 acres of vegetation. The total affected area is likely to increase somewhat, even under a No Action development scenario. The Preferred Alternative could result in vegetation die-off on 340 acres, in addition to the 300 acres affected by the existing CBM well field.

- There are two homes on the outcrop of the Fruitland Formation in the eastern Project Area, off Fosset Gulch Road, west of the Piedra River. These homes may be affected by methane seepage and buildup associated with CBM development in the area.

- The amount of methane lost to seepage at the outcrop areas would increase along with the overall number of active seeps. Approximately 15 miles of outcrop area would be subject to increased seepage.

## Minerals and Geology

The Project Area lies entirely in Colorado, within the Colorado Plateau physiographic province. This province extends throughout western Colorado, northwestern New Mexico, northeastern Arizona, and southern and eastern Utah. Characteristics of this physiographic province include an expansive, dissected, high-elevation land surface with relatively low relief when compared with surrounding mountainous regions. Additional CBM development raises the following concerns: potential for geologic and paleontological impacts; conflicts with other mineral development; potential for landslides due to construction in unstable areas; potential for underground injection of produced water to trigger earthquakes; and potential for coal fires. Key findings:

- CBM development would alter naturally occurring outcrops and deposits whenever surface exposures are excavated. The stratigraphy, structure, and contacts between geologic units would not be affected, however.

- Little of the Project Area has been inventoried for the presence of paleontological resources. As a result, the number of paleontological sites that may be affected cannot be accurately estimated. Paleontological resources contained in near-surface horizons of soil and surficial deposits have likely already been impacted by natural processes or human activity. Surface use and shallow excavations likely would have little or no effect on paleontological resources that occur just below the surface. All facilities constructed on federal mineral ownership would be considered federal undertakings, and thus would be subject to federal guidelines and regulations that protect paleontological resources.

- Because there are no active coal mines in the Project Area, CBM development is not expected to impact coal mining. Locating wells in areas where future mining may take place would preclude mining during the life of CBM wells located in the area proposed for mining. Coal in these areas could be mined after CBM extraction ceases or is terminated, or through a negotiated agreement between the CBM lessee(s) and operator(s), and the coal lessee(s) and coal mine operators.

- Surface disturbance could exacerbate existing landslides and cause new landslide hazards in the Project Area. Based on the preliminary location of proposed access roads, 15 miles of new roads would cross high landslide hazard areas. Additionally, 17 proposed well pads would require cut and fill construction in areas of high landslide hazard. Landslides could be activated during facility construction. However, the use of facility design and construction best management practices and mitigation measures that minimize the risk of landslides would landslide potential within the Project Area.

- No excessive buildup of pressure within rocks or fracturing of rocks are anticipated to result from produced water injection. Therefore, no underground injection triggered earthquakes would be expected. Underground injection would be conducted in accordance with federal and state regulatory requirements. Injection wells would be authorized only where the injection zone is sufficiently porous and permeable that fluids could enter the rock formation without causing an excessive buildup of pressure or fracturing of rocks.

- Removal of water from the Fruitland coal seam would not cause noticeable ground subsidence or aquifer compression in the Project Area under any of the alternatives. Water would be extracted from the Fruitland formation, which is a consolidated rock unit and, therefore, would not be susceptible to noticeable subsidence.

- Partial removal of water from the coal seam near the coal outcrop during CBM development depressurizes the coal seam and could create a condition where oxygen replaces water in the coal seam and increases the risk of spontaneous combustion. The risk of underground coal fires would be limited to the area where oxygen is available to sustain coal fires. Oxygen would be introduced to the shallow subsurface environment through conduits to the surface, such as well bores or naturally occurring fractures. Water pumped from the Fruitland coals miles away from the outcrop would affect the water levels and, consequently, the risk of coal fires near the outcrop. However, unless enough oxygen is able to reach the dewatered coals to sustain combustion, underground coal fires would not occur. The conditions affecting the availability of oxygen near the outcrop would not be expected to vary among the alternatives, provided proper well drilling and operation procedures are followed.

## Ground Water

The Fruitland Formation and Pictured Cliffs Sandstone are unconfined at the outcrop where they are recharged. The aquifer is confined several hundred meters down dip and throughout the San Juan Basin, where the overlying Kirtland Shale acts as an aquitard. Flow of groundwater in the Fruitland Formation occurs primarily in the higher-permeability coal beds. Although coal beds are not laterally continuous across the entire Project Area, they are sufficiently interconnected to allow the Fruitland Formation to act as a single aquifer system. Flow within the Pictured Cliffs Sandstone appears to occur in fracture zones and in some areas of higher primary permeability. Groundwater concerns include: the potential for CBM dewatering to deplete groundwater in shallow aquifers; the effect of groundwater withdrawal on outcrop seeps and springs; effect of produced water injection on basin hydrology; and the effect of dewatering and injection on groundwater. Key findings include:

- Dewatering the coal beds will not affect the shallow aquifers within the interior of the Basin that supply almost all the domestic wells, municipal wells, and livestock wells within the Project Area. Increased CBM development will, however, continue to draw down the water levels in wells located along the outcrops of the Fruitland and Pictured Cliffs formations. As many as 20 well owners may be affected by lower water tables in the outcrop area. The two deeper wells known to draw water from the Pictured Cliffs Sandstone are not likely to be affected to any significant degree by increased CBM development. Rather lowering of the water levels in these two wells will continue as a result of the existing level of CBM development.

- Draw down of the water table along the outcrop may affect groundwater seeps and springs. Impacts in the western Project Area are not expected to increase as a result of the Proposed Action. In the eastern portion of the Project Area, the water table along the outcrop would be draw down, possibly affecting springs and seeps.

- Although the deep hydrology of the Basin would be affected by injection of produced water, these impacts are not expected to manifest themselves in shallow aquifers or usable groundwater supplies. Impacts would not be evident because injection wells are constructed and operated according to current regulations and best engineering practices.

## Surface Water

There are four main stem rivers within the Project Area. They are, from east to west, the Piedra River, Los Pinos River (Pine River), Florida River, and Animas River. The Piedra River is an unregulated stream that flows from the northeast directly south to Navajo Reservoir. The main tributary east of the Piedra River within the Project Area is Stollsteimer Creek, which has its confluence with the Piedra River just south of the Project Area. West of the Piedra River are several ephemeral steams, including Squaw Creek, Fosset Gulch, and Bull Creek. In addition, Turkey Creek, Goose Creek, and Ignacio Creek also drain portions of the Project Area on an intermittent basis, but have their confluence with the Piedra River just south of the Project Area within the Southern Ute Indian Reservation.

CBM development concerns include: the potential for surface water degradation as a result of petroleum product and produced water spills; the potential for reduced surface water flow to affect riparian areas and wetlands; the consumption of domestic and irrigation water for well development; and the effect of water depletions on existing surface water rights. Key findings include:

- Potential short-term surface water quality impacts could occur as a result of accidental spills of fuel, lubricants, and fluids during facility construction in water influence zones (WIZ). Long-term impacts over the life of the project could occur from leaks or breaks in the pipelines that run from the wells to the disposal facilities. To mitigate these impacts, facilities would be located outside of the WIZ, where possible, and operations would adhere to spill prevention control and countermeasures (SPCC) plans that incorporate best management practices (BMPs).

- CBM development would impact 92 acres of water influence zone (WIZ) in the short term and 63 acres in the WIZ in the long-term after partial facility reclamation. This disturbance would lead to potential annual sedimentation within the WIZ of 842 tons per year in the short term and 565 tons per year in the long term. Well pads and roads would be relocated or realigned where possible to avoid WIZ disturbance where possible. Complete avoidance would not be possible.

- Depletions are predicted to be less than one percent of base flow in the Animas, Pine, and Florida Rivers. Localized impacts to wetland and riparian areas could occur along perennial and ephemeral drainages crossed by access roads.

- Springs and seeps may be affected by reduced surface flows caused by dewatering. Proposed wells could be relocated to physically avoid these moist areas.

- Over the life of the project, 156 acre-feet of water would be required for drilling. Water would be purchased from municipal sources, private entities, or produced water would be used. Individual landowners would negotiate terms for the purchase of water. In total, about 0.03 percent of irrigation use would shift to industrial use.

- The process of dewatering the Fruitland coal bed to free gas would physically reduce the amount of Fruitland formation recharge of local rivers. Existing water users would be affected by annual 140 acre-feet depletions in the Florida, Pine, and Animas Rivers and 15 to 60 acre-feet depletion in the Piedra River, particularly during irrigation season when many streams in the Project Area are over-apportioned. Existing surface water rights would be impacted.

## Soils

Soils within the Project Area have developed in residuum, colluvium, alluvium, and, to a lesser extent, in eolian materials derived from inter-bedded sandstones and shales in the lower areas. They also have developed from igneous and metamorphic materials in the higher, more mountainous areas. Surface textures range from clay loams to sandy loams with varying amounts of gravel or coarser materials. Slopes range from nearly level to very steep, with deeper soils found in the less steeply sloping areas. Additional CBM development presents concerns about constructing facilities in areas with sensitive soils and high potential for erosion, and within water influence zones. Key findings include:

- CBM development would impact 68 acres of soils with high potential for water erosion and 90 acres of soils with high potential for wind erosion during construction. During operation and maintenance, 79 acres of soils with high potential for water erosion and 31 acres of soils with high potential for wind erosion would remain impacted after partial reclamation of facilities.

- There would be limited surface disturbance within the Ute/Springs Creek, Middle Piedra River and Lower Piedra watersheds where the majority of the severe slopes in the Project Area exist.

- Overall, 92 acres of surface disturbance would occur within water influence zones during construction; 63 acres would remain impacted within WIZs during operation and maintenance. Projected additional soil erosion above baseline from all impacted portions of the Project Area would be 8,275 tons per year during construction and 5,834 tons per year during operation and maintenance. Approximately 842 tons of soil would be expected to erode annually as a result of construction in WIZ. Five hundred and sixty tons of soils are projected to erode annually during operation and maintenance within WIZ.

## Vegetation

There are nine general vegetation types found in the Project Area: grasslands, sagebrush, pinyon-juniper, mountain shrub, Gambel oak, ponderosa pine, mixed conifer, aspen, and riparian. Across the landscape, many of these vegetation types occur in a mosaic, depending on slope, aspect, soil type, and other physical parameters. Three additional land cover types, agriculture, barren, and water, are also found in the Project Area. CBM development raises concerns about effects of facility construction on vegetation, including wetlands, riparian areas, and old growth ponderosa pine forests. Key findings include:

- Approximately 870 acres of vegetation would be removed where well pads, compressor stations, pipelines, and roads are constructed. Ponderosa pine, pinyon-juniper, and gambel oak would be the cover types most affected. Facilities would be partially revegetated following construction. Full reclamation would occur after the production phase.

- Loss of wetlands and riparian areas may occur despite the intention to avoid these environmentally sensitive areas whenever possible. Well pads and compressor stations would be located in upland sites where they would not impact wetlands and riparian areas. Linear facilities would not be constructed across perennial streams and rivers where wetlands and riparian areas are most common and generally best developed. Linear facilities would, however be constructed across approximately 128 intermittent streams where some wetlands and riparian vegetation may exist and be impacted. Best management practices would be utilized to reduce effects of CBM-related sedimentation to wetlands and riparian areas.

- Weed seeds may be introduced accidentally as a result of project activity. The probability that noxious weeds would be introduced cannot be quantitatively predicted. However, infestations of noxious weed infestations have been found in association with ground disturbance from existing CBM development on federal and private lands in the Project Area. Control of existing noxious weed infestations on federal lands has generally been successful, while results have been mixed on private lands. Mitigation measures designed to prevent the introduction and spread of noxious weeds would be implemented. However, complete prevention and control of weeds is unlikely.

- Portions of old-growth ponderosa pine stands may be removed by construction. Without avoidance mitigation, the Preferred Alternative would impact 36 acres of old growth pine, approximately 4-percent of the old-growth present on the National Forest portion of the Project Area. To the extent practical, old growth stands would be avoided during road and well pad staking. However, until firm locations are proposed during APD submittal, the effective ability to move facilities to avoid old-growth impact is unknown.

- During the development phase of the project, cut trees and limbs would be present along roads and at well pads and may increase infestations of the *Ips* beetle. By attracting more beetles, the surrounding trees that are not directly affected by construction would be at greater risk of insect attack. Mitigation measures designed to ensure timely removal of wood from construction areas would be implemented to reduce the potential for increased insect populations from CBM development.

- One federally listed plant species, four Forest Service sensitive plant species, and two BLM sensitive plant species may occur in the Project Area and may be affected by the proposed project. Pre-construction surveys for these species would be conducted in all suitable habitat and impacts minimized by avoidance mitigation.

## Wildlife and Fisheries

The Project Area is located at the interface of the Colorado Plateau physiographic province and the Southern Rocky Mountains physiographic province. The location of the Project Area at this interface makes it valuable to many species of wildlife. Wildlife species and habitat elements common to both of these physiographic provinces are found in the Project Area. Species that utilize the higher, moister, conifer-dominated habitats of the Rocky Mountains are found in the eastern third of the Project Area. Species more typical of the warmer, drier Colorado Plateau occur in the western two-thirds of the Project Area. Migratory species, such as big game and many bird species, move back and forth across the Project Area with the seasons. Of concern is whether increased CBM development would result in increased wildlife harassment, road-kill, hunting pressure, and wildlife displacement; the potential for loss of suitable wildlife habitat; habitat fragmentation; disruption of migration routes; and loss of long-term viability of wildlife populations. Of further concern is how additional CBM development would affect Federal and State listed threatened, endangered, proposed, candidate, and sensitive animal species and their habitats. Key findings include:

- Direct loss of 870 acres wildlife habitat would occur during the construction phase of the project, as a result of road, well pad, and other facility construction. Habitat loss would reduce available forage and habitat components in the affected area. Habitats next to those directly disturbed may be degraded by changes in vegetation, including the invasion of noxious weeds. The amount of habitat directly impacted by the Preferred Alternative CBM development would be one-percent or less of available habitat for each MIS.

- Most of the habitat impact would be on national forest in the HD Mountains because it is currently the least developed and would experience the most new development. The west side of the Project Area is extensively developed agricultural and residential land and has experienced the most CBM development to date. Future CBM development on the west side of the Project Area would add a small increment of direct habitat loss to the landscape. To partially offset direct habitat loss, unused portions of well sites would be restored during the production phase. At the end of the production phase, all facilities would be removed and disturbed areas restored to pre-construction vegetation types.

- Approximately 95 miles of new road would be constructed under the Preferred Alternative. These roads would provide increased access to public land in the Project Area as a whole, potentially leading to increased legal-hunting pressure and poaching. Most newly constructed roads would be gated and locked to reduce motorized access and human-wildlife impact.

- Displacement during the construction phase may alter patterns of habitat use and movements for individual animals, but would result in only minimal, overall disruptions of seasonal habitat use or movement for entire herds because of the large areas occupied by these herds and the scattered nature of anticipated development. Displacement during the production phase would result in only minimal alteration of habitat use and movement patterns for both individual animals and entire herds, because of habituation to regular low-grade disturbance.

- Most project roads would be designed for slower speeds and not likely to cause any substantial increase in vehicle collisions. Most collisions occur on county roads and highways, where speeds are greater and where the vast majority of traffic is not CBM-related. Nevertheless, an increase in CBM traffic would occur on these roads, as well, and a minimal increase in vehicle collisions may occur.

- Construction and operation of project-related facilities would result in the fragmentation of wildlife habitats in the Project Area and on NFS land. Fragmentation would occur through loss of narrow strips along roads and small patches at well pad and facility sites. The extent of this fragmentation is substantially different than the type of fragmentation that has been studied extensively in other areas. Habitat loss would occur as narrow strips and small patches within a largely unaffected matrix, as opposed to widespread habitat loss with a few, small remaining patches of unaffected habitat.

- MIS populations are considered viable and well distributed across the region, the National Forest, and project area. Reduced population is generally a concern if a substantial proportion of available habitats is lost or reduced in effectiveness for a long period. The project would not contribute measurable to an alteration of the stable population trends for MIS species that prevail at the National Forest unit level. Nor are substantial losses of habitat projected for any of the alternatives on NFS land, or in the Project Area. On private lands, there may be reduced population levels in the Project Area's west side, where residential development has accelerated over the past decade.

- The current Rocky Mountain Region endangered, threatened, proposed, and sensitive species list (FS 2001) contains special status species of concern within the region. Based on a screening of the list, we determined that Canada lynx, bonytail chub, humpback chub, and Uncompahgre fritillary butterfly are not expected to occur in the Project Area. Species thought to occur or that have suitable habitat within the project area include: Bald eagle, Mexican spotted owl, Southwestern willow flycatcher, Colorado pikeminnow, razorback sucker, and Knowlton's cactus.

- The Preferred Alternative may affect but is not likely to adversely affect the bald eagle, Mexican spotted owl, southwestern willow flycatcher, and Knowlton's cactus and their habitat in the Project Area.

- It has been the position of the FWS that any depletion of water from the San Juan Basin, regardless of magnitude, timing, duration, or source, contributes to the overall cumulative effect of water depletions on the endangered fishes and has the potential to jeopardize the population viability. In keeping with previous findings for like actions, the Preferred Alternative may affect, and is likely to adversely affect, the Colorado pikeminnow and razorback sucker.

- There are 19 Forest Service and BLM sensitive species that were analyzed in detail and 16 species that were eliminated from further analysis because they are not expected to occur in the Project Area. The Preferred Alternative would not impact a number of these species, but for other species evaluated in detail, the Project may adversely impact individuals, but is not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability range wide.

## Cultural Resources

Cultural resource sites include the physical locations and material remains of past and present cultures, including properties of traditional religious and cultural importance (hereinafter called traditional cultural properties), and areas of traditional use. The principal issues regarding cultural resource sites, traditional cultural properties, and areas of traditional use in the Project Area are the potential direct, indirect, and cumulative effects of further CBM development. Key findings:

- Potential effects to historic properties from continued CBM development in the Northern San Juan Basin would include destruction and deterioration of prehistoric and historical objects, structures, buildings, sites, districts, and cultural landscapes that represent the patterns, traditions, and achievements of human societies in this region. These effects would result from development and operation of CBM facilities and from incidental or ancillary activities that are associated with development and operation.

- Based on the information from past investigations and known sites in the OAHP Cultural Resource Survey database, approximately four historic properties on federal surface may be affected and, therefore, may need to be considered in project development. Measures can be implemented to avoid the impacts for the majority of the properties under federal jurisdiction.

## Land Use

The pattern of surface ownership is distinctly different in the western and eastern portions of the Project Area. Surface ownership in the western half of the Project Area consists primarily of private property intermingled with federal (BLM) and state lands. The BLM San Juan Center administers the federal lands within the San Juan/San Miguel Planning Area. The eastern half of the Project Area is mostly federal land within the SJNF, administered by the Forest Service Columbine Ranger District. Land use concerns include: the effect of additional CBM development on agricultural and residential land uses; whether CBM development would be consistent with the adopted land use plans and policies of federal, state, and local agencies; and the effects of additional development on the HD Inventoried Roadless Area and roadless lands in general. Key findings include:

- Land use conflicts are most likely to occur where CBM wells are located on split estate properties that have private surface ownership without mineral estate ownership (severed minerals). In some cases, landowners are not aware of the severed mineral rights until they receive a notice that the lessee intends to drill a well on the property. The specific locations for CBM facilities would be negotiated with landowners on split estate lands, and the agency requires an executed landowner agreement for drilling approval when federal mineral estate is involved. A well can be drilled without a binding landowner agreement but this action is normally preceded by legal action and a court order allowing a well to be drilled under protest with actually damages between contestants being determined after drilling. Surface owners would generally be compensated for the value of land displaced by CBM facilities. There have been, and most likely will continue to be conflicts between some surface and mineral estate owners over the adequacy of compensation.

- An increase in the number of roads constructed in grazing areas and additional project-related traffic would increase the potential for disturbance or harassment of animals or collisions with livestock. New access roads or additional fencing that bisects fields may also fragment rangeland and limit movement of livestock.

- Conflicts would continue where CBM development encroaches on subdivisions and individual residences. The land use codes designed to reduce CBM development impacts cannot fully mitigate these land use conflicts. These conflicts are particularly acute where surface landowners derive no monetary benefit from the well's production and incur possible property value loss due to CBM development.

- Intrusive effects to adjoining or nearby residential properties would occur from the sights and sounds of CBM-related activities. These effects may include increased fugitive dust, noise, and traffic delays on the roads; physical intrusion of the crew and equipment; and visual or aesthetic effects that could devalue residential properties. Some of these effects would occur during the construction phase of CBM development and would be limited in duration because a well drilling would be completed within several weeks.

- Fifty-seven well pads and 38 miles of road would be constructed in the unroaded portion of the HD Mountains. Approximately 44 percent of the existing unroaded area would be impacted, leaving a residual area of 15,159 acres unroaded. The remaining area would form two smaller, non-contiguous blocks of 11,776 and 3,383 acres respectively within the core of the HD Mountains. The spine of the HD Mountains Inventoried Roadless Area would be developed from the terminus of FSR 756 in a north-south pattern that approximately follows the old stock driveway.

## Recreation

The landscape in the Project Area ranges from rural on private land in La Plata County to a mostly natural-appearing national forest in the eastern half. Oil and gas operations have added an industrial component to the landscape, primarily on state, and private land in La Plata County. Additional wells would increase this industrial component of the landscape and add new sources of vehicle traffic and noise that would diminish the recreational experience and alter the rural ambience sought by recreationists. The gas well access roads would be gated and closed to public motorized use. Key findings include:

- Local residents value the federal land for recreation because of its proximity and the relative solitude that can be achieved within a short distance from their home. The solitude and natural setting now experienced on this public land would be most impaired by the project during the 5-year construction period. Recreationists would encounter wells and roads where there had been for the most part, natural appearing landscapes.

- In partially developed portions of the Project Area, the number of wells would double, further altering the natural appearance of the landscape and the backcountry ambiance of the area. Access to the SJNF would be altered by development of an extensive road system. The opportunity for solitude and the ability to recreate in an undeveloped landscape would be lost over much of the Project Area. This impact would continue through the life of the project.

- Construction-related noise would reduce the quality of the recreational experience in general whenever a recreationist is near construction. Noise levels could increase in the long term in localized areas, as well, because of CBM compressors and continued use of pumps.

- Change vehicular travel management throughout the SJNF portion of the Project Area from the current policy that allows motorized vehicle travel off roads or trails to management that restricts motorized travel to designated roads and trails only. Off-road or off-trail motorized travel would be prohibited. (Applies to Alternatives 1 through 3.)

## Transportation

The transportation network that serves the Project Area consists of federal and state highways, county roads, National Forest System Roads (NFSRs), and BLM roads. Workers and vehicles hauling equipment and supplies to the Project Area would use this network. Three types of impacts are of concern: additional traffic on county roads and existing roadway congestion; the potential for increased traffic accidents in the Project Area; and conflicts with public access to existing residential uses from CBM traffic on county roads. Key findings include:

- The largest increases from CBM-related traffic would occur on County Road (CR) 223, averaging 27 daily vehicle trips for each year from the current year through 2020. The maximum projected ADT for all vehicles is 385 in 2020. The total daily traffic of about 412 vehicles in 2020 is within the maximum design capacity of 999 for CR 223. County Road 225 and CR 501 are the other county roads that would experience increases that exceed 1 percent in daily traffic from additional CBM maintenance vehicles. These increases slightly exceed 1 percent of the ADT for the base year of 1998.

- County Road 228, CR 234, CR 501, and CR 509 include road segments where the rate of accidents is high. These roads provide access to residential subdivisions within and north and south of the Project Area. The increase in daily traffic levels projected from anticipated CBM-related maintenance traffic is small between 2003 and 2020. Impacts beyond 2020 are expected to be similar in magnitude and intensity. There would be no perceptible effect on the overall rate of accidents on county roads because the volume of traffic from anticipated CBM development on most of these roads is projected to be less than 1 percent.

- Light trucks account for about 29 percent of the total number of trips by CBM construction vehicles. The costs for road maintenance from light trucks are the same as from deterioration caused by other passenger vehicles. The total vehicle trips by 31,800 light trucks would be spread out over an estimated 5-year construction period for all wells proposed for the Project Area. Light-truck traffic associated with each well would be temporary, occurring over an estimated construction and installation period of 2-3 weeks.

- Heavy truck traffic would account for about 25 percent of the total number of trips by CBM construction vehicles. Heavy truck traffic would result in increased costs for road maintenance because they cause more damage to road surfaces of all types than do automobiles and light trucks. It is anticipated that county road maintenance cost would increase from construction-related truck traffic.

- When the project is complete, all roads constructed specifically for the project would be removed, with the exception of those roads that remain open to the public during the duration of the project and those that the Forest Service retains for administrative purposes.

## Visual Resources

The western portion of the Project Area is characterized by rolling hills, mesas, plateaus, and hogbacks, interspersed with broad to narrow drainages. The eastern portion of the Project Area consists of mountainous terrain mixed with upland hills, rolling uplands, ridges, and narrow valleys, as well as river valleys. Public sensitivity to landscape modification is relatively high. Reflecting this sensitivity, current objectives for management of visual resources on public land control the degree of alteration that may be allowed in the landscape. Key findings:

- Long-term impacts would result from the addition of wells and access roads to the landscape and the permanent disturbance of land that would be used for associated facilities, such as gathering lines, well service roads, and access roads. The most visible component of the proposed facilities would be the pumping units at each well site. Gas-gathering and water pipelines would be buried adjacent to rights-of-way for existing and new roads.
- During the 6- to 12-day construction period, the presence of heavy equipment and dust generated by construction and traffic would detract from the visual quality of the landscape at each well location. These actions could conflict with residential and recreational uses because they would be visually and audibly intrusive. Night lighting would also be visible during this period, because drilling occurs on a 24-hour basis. Visual impacts would be greater for well locations near residential areas, along roads, and in open areas that are not screened by topography or vegetation. Construction would be spread over the 5-year construction phase.
- After construction is complete, well pads, new access roads, and pipeline and utility trenches would all appear as visible alterations of the landscape. Exposed soils and rock would replace landscapes that had previously been covered with natural appearing vegetation. These disturbed locations would present a visible contrast to the observer for a period of several months to several years. The duration of this impact would depend on the success of revegetation.
- The addition of wells and associated access roads would result in a mixed rural and industrial landscape. Development in the western portion of the Project Area would incrementally alter an already modified landscape character that has been impacted by residential, commercial, agricultural, and gas well development. The components with the highest potential to affect the visual character of the area adversely are the well pad clearings, pumping units, access roads, and pipelines. Operation of the proposed facilities would introduce new elements of form, line, color, and texture into the landscape

and would essentially dominate foreground views. They would be visible in middle ground and background views in flat areas that are less vegetated.

- Nighttime lighting of compressor stations also would result in increased viewshed sensitivity. Permanent yard lighting has historically been installed for safety and security. This lighting typically consists of low-pressure sodium vapor fixtures arranged around the site so that the equipment can be safely operated during darkness.

## Noise

Elevated noise levels would result from vehicles and operation of construction equipment during each phase of construction. Construction noise would be temporary, however, at each location. Well pad construction would last less than 30 days. Road construction would require about 7 days for each mile. Key findings:

- Noise during the drilling phase would exceed pre-existing levels (74 dBA at 200 feet from the rig). Additionally, it would ensue 24 hours a day for the 8 days that are generally needed to drill a CBM well. During the operational phase, sources of noise would then be limited to periodic vehicle trips to the well sites and the pump jacks. Noise emanating from pump jacks would range from 67 dBA at 50 feet from the well to 50 dBA at 375 feet.
- A Caterpillar model 3516 is an example of the engines that would be installed at compressor stations. The exhaust produces a noise of 109 dBA at 4.9 feet. The mechanical noise from the engine produces 99 dBA at 3.2 feet. The enclosed building where the compressor engine operates would reduce noise by about 20 dBA. Therefore, the effective noise level would be 89.4 dBA at 5 feet from the edge of the building enclosure. The noise emanating from the compressor would decrease to 55 dBA (the COGCC daytime limit) at 250 feet from the edge of the compressor building, and to 50 dBA (the COGCC nighttime limit) at 450 feet from the building.
- Although noise levels near all CBM facilities would be similar, CBM development in the eastern portion of the Project Area would occur on NFS land distant from populated areas and would not affect established NSAs. CBM development noise could affect NSAs in the western portion of the Project Area, however. Proposed development involves 69 well locations or windows proposed within or immediately adjacent to the existing and proposed subdivisions.

## Social and Economic Values

Social and economic issues include: the effects of CBM development on tourism and tourism revenues and the sales tax revenue, employment, and income tax proceeds derived from tourism; potential for creating a boom or bust economy; the impact of continued CBM development on county revenues from gas royalties and taxes; impacts on demographics, employment, and infrastructure; and the effect of gas wells on residential property values. Key findings:

- CBM and conventional gas development has not affected tourism for the past 10 years and is unlikely to affect tourism during the life of the project.

- Revenues, jobs, and personal income would likely peak by the year 2010 and gradually decline until gas production ends about 2035. Although CBM revenues and jobs would gradually decrease, the population is projected to steadily grow. The two counties could direct some of the gas revenues toward future years. Long-term growth and diversification would likely somewhat offset the gradual decline in CBM revenues.

- County revenues would be in the form of *ad valorem* property taxes. It is estimated that La Plata County would receive $33 million over the life of the project, and Archuleta County would receive $17 million. Sales tax revenues would be minimal because most of the purchases of CBM equipment and personal purchases by employees would be outside of the counties.

- Employment associated with CBM development would be 2 percent of total employment. With 930 new jobs, the population increase would be insignificant.

- Property values have increased by about 7 percent per year during the past decade. Although some property values may decrease in close proximity to wells, they would be expected to increase in value after the life of the project at the same relative rate as properties distant from wells.

## Health and Safety

Health and safety concerns include: the risks to human health associated with underground coal fires; health risks of hydrogen sulfide seeps; the potential for accidental spills from generation, handling, and storage of hazardous and nonhazardous chemicals and wastes. Key findings include:

- Risk of ignition or re-ignition of coal fires would be low to moderate.

- Since the overwhelming majority of existing CBM wells do not produce hydrogen sulfide, the risk of exposure is extremely low.

- The risk of a spill would be proportional to the amount of chemicals and hazardous materials transported, stored, and used. The operator's adherence to regulations and required environmental health and safety plans would minimize the potential for spills.

- Standard safety procedures for drilling, pipeline markers, monitoring, and inspections are required to minimize the probability of a well blowout, undetected gas leak, or well fire. Adherence to these procedures and development of emergency plans with defined fire prevention and fire fighting procedures minimize the risk.

## Air Quality

Fugitive dust and exhaust from construction activities, along with air pollutants emitted during operation (i.e.; separation and dehydration heaters, and pipeline compression engines), are potential causes of air quality impacts. These issues are more likely to generate public concern where natural gas development activities occur near residential areas. The USDI-National Park Service and the USDA-Forest Service have also expressed concerns regarding potential atmospheric deposition (acid rain) and visibility impacts within distant downwind mandatory federal Prevention of Significant Deterioration (PSD) Class I areas under their administration (Mesa Verde National Park and the Weminuche Wilderness Area). Key findings include:

- Significant air quality impacts would not occur under the Preferred Alternative. No violations of applicable state, tribal, or federal air quality regulations or standards are expected to occur as a result of direct or indirect CBM development-related air pollutant emissions (including construction and operation).

- Operation emissions would occur due to natural gas-fired separator and dehydrator heaters, and increased compression requirements. It is anticipated additional field-wide compression would be approximately 42,500 hp (at 14 new compressor stations). Since produced natural gas is nearly pure methane and ethane, with little or no liquid hydrocarbons, no significant direct $SO_2$ or VOC emissions would occur.

- Potential direct atmospheric deposition (acid rain) and visibility impacts to the Mesa Verde National Park and Weminuche Wilderness PSD Class I areas were also calculated. The maximum direct total (wet and dry) nitrogen deposition within these areas during operation were predicted to be nearly 0.009 kilograms per hectare-year (kg/ha-yr) and 0.007 kg/ha-yr, respectively; well below the 3 kg/ha-yr threshold). In addition, potential changes in Acid Neutralizing Capacity (ANC) at four lakes within the Weminuche Wilderness Area were all predicted to less than 0.8 per cent (calculated for Upper Grizzly Lake), well below the 10 per cent threshold for sensitive lakes.

- Potential direct visibility impacts were calculated based on observed relative humidity, as well as speciated aerosol concentrations measured between 1988 and 2002 at both Mesa Verde National Park and the Weminuche Wilderness Area. If the air quality impacts predicted under Alternative 1 - Industry Proposed Action had occurred during the observed visibility measurement period, a 1.0 deciview "just noticeable change" would not have been exceeded at Mesa Verde National Park on any day, and would have been exceeded between 0 and 3 days per year at the Weminuche Wilderness Area. However, given the "reasonable, but conservative" assumptions incorporated into this analysis, these direct impacts are not likely to occur.

## Cumulative Effects

The cumulative impacts of CBM development are of concern. The general cumulative effects area is the Project Area (125,000 acres) and the area within the bounds of the Southern Ute Reservation that has and will continue to experience oil and gas development over the next decade (422,000 acres). The general cumulative effects area for most resource evaluations is therefore 547,000 acres. Air quality, fisheries, economic, and social impacts, however, encompass a larger area that includes the New Mexico portion of the San Juan Basin.

In general, cumulative impacts over the larger geographic area would be as described above on a resource-by-resource basis. However, the geographic extent of impact is greater and would be more or less uniformly distributed across the entire cumulative effects area. The intensity and duration of impacts within the bounds of the Southern Ute Reservation and the Project Area would be the same.

The non-oil and gas impact of greatest concern is continued residential development within La Plata County. Residential development continues to fragment wildlife habitat and reduce wildlife habitat effectiveness. Continued CBM gas and residential development will also result in greater social conflict because of proximity of CBM development to residences, thereby resulting in increased visual and noise impacts, and possible property value impacts.

Air quality concerns are a function of existing and projected oil and gas development and other cumulative emission sources within the Colorado and New Mexico portions of the San Juan Basin. Although most of the predicted impacts are below significance thresholds, the USDI-National Park Service and USDA-Forest Service visibility “Limit of Acceptable Change” of more than a single day above a ‘just noticeable change’ (FLAG 2000) could be exceeded between 9 to 21 days per year at the Weminuche Wilderness PSD mandatory federal Class I area, and 14 to 31 days in the Mesa Verde PSD Class 1 Area. Combined Colorado and New Mexico federal mitigation efforts could reduce visibility impacts to between 2 to 15 days in the Weminuche Wilderness and 4 to 11 days in Mesa Verde National Park.

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# Appendices

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# Chapter 1
# Purpose and Need

# Chapter 1 — Purpose of and Need for the Proposed Action

## 1.1 Introduction

Pure Resources, XTO Energy, Petrox Resources, Elm Ridge Resources, Exok, and British Petroleum ("the companies") propose to drill approximately 300 wells to produce natural gas from coal beds on Federal, State, and privately-owned lands in La Plata and Archuleta Counties, Colorado. The companies would also construct ancillary facilities needed to support the wells. The companies' proposal includes directional drilling to avoid steep slopes in portions of the HD Mountains, where feasible.

## 1.2 Purpose and Need

Private industry exploration and development of federal oil and gas leases is an integral part of the BLM's oil and gas leasing program under the authority of the Mineral Leasing Act of 1920, as amended, the Mining and Mineral Policy Act of 1970, the Federal Land Policy and Management Act of 1976, the National Materials and Minerals Policy, Research, and Development Act of 1980, and the Federal Onshore Oil and Gas Leasing Reform Act of 1987.

Exploration and production of natural gas, including methane gas from coal-bearing formations, is in accordance with the President's National Energy Policy, Executive Order 13212. The policy calls for federal agencies "to develop a national energy policy designed to help the private sector, and, as necessary and appropriate, State and local governments, promote dependable, affordable, and environmentally sound production and distribution of energy for the future." Natural gas is an integral part of the U.S. energy future due to its availability, the presence of an existing market delivery infrastructure, and the environmental advantages of clean burning gas.

The purpose and need for this project is to allow the companies to drill to develop their federal oil and gas leases and to help meet the public's need for natural gas by increasing the number of wells that produce coal bed methane (CBM). The proposed CBM development would exercise the leaseholders' existing rights to drill for, extract, remove, and market gas products. National mineral leasing policies and the regulations by which they are enforced recognize the statutory right of lease holders to develop federal mineral resources to meet continuing needs and economic demands so long as undue and unnecessary environmental degradation is not incurred. Also included is the right of the leaseholder within the project area to build and maintain necessary improvements, subject to renewal or extension of the leases in accordance with the proper authority.

This project would serve to meet the goals for management of energy minerals set forth in the Land and Resource Management Plan (LRMP) for the San Juan National Forest (FS 1983) and in the Resource Management Plan (RMP) for the San Juan/San Miguel Planning Area (BLM 1985).

## 1.3 Project Area

This environmental analysis of the companies' gas field development proposal focuses on a 125,000-acre Project Area in the Northern San Juan Basin (NSJB) of Colorado. The Project Area is that portion of the San Juan Basin north of the boundary of the Southern Ute Reservation, bounded on the south by the reservation and to the west, north, and east by the arcing line of the outcrop at the top of the Fruitland Formation.

The Project Area consists of 7,000 acres of Bureau of Land Management (BLM) administered land; 49,000 acres of U.S. Forest Service (FS) administered land, 9,000 acres of private lands with federal minerals, and 60,000 acres of state or privately held (fee) lands with non-federal minerals. The Project Area occupies portions of La Plata and Archuleta Counties (Figure 1–1).

## 1.4 Scope of Agency Decisions

This environmental impact statement (EIS) and its supporting project record are the basis for the Record of Decision (ROD) that will document the following BLM and FS decisions:

(1) Overall plan and conditions of development, including environmental protection measures that apply to the entire Project Area, or to portions of the area.

(2) Conditions under which ancillary facilities requested by the proponent may be constructed (including water and gas flowlines and compressor stations on National Forest System [NFS] or BLM lands).

(3) Conditions of approval specific to the 56 pending surface use plans of operation (SUPOs) and applications for permit to drill (APDs) submitted by the companies.

(4) Whether to waive, allow an exception for, or modify the no surface occupancy stipulations issued May 14, 2001, on five leases within the Project Area, COC64932, COC64933, COC64934, COC64935, COC64936.

(5) Whether to continue or to terminate in whole or in part the Interim Criteria for development within the Project Area as described in Notice to Lessees (NTL) No. CO-SJFC-2000-01. The Interim Criteria are described below.

These decisions will incorporate the terms and mitigation requirements that the agencies deem necessary to protect the surface and sub-surface resources based on disclosure of environmental effects in this EIS for CBM gas field development.

These approvals are contingent on decisions regarding:

(1) How the companies' drilling plans can be carried out in accordance with the stipulations set forth in the leases and in applicable federal laws;

(2) To the extent consistent with the rights conveyed with the leases, whether the APDs and SUPOs are consistent with current BLM and FS policies, regulations, and the approved LRMP and RMP;

(3) Whether the surface use plans of operations meet or exceed the surface use requirements of FS regulation codified at Title 36 Code of Federal Regulations (CFR) Part 228.108 and the BLM regulation at 43 CFR 3162.5–1; and

(4) Whether the surface use plans are acceptable to the authorized Forest Officer based on review of the environmental consequences of the operations.

Project decisions will be documented in a ROD signed by the BLM and FS responsible officials and will apply to federal lands and minerals only. The private mineral estate is under the administrative jurisdiction of the Colorado Oil and Gas Conservation Commission (COGCC) and is not subject to the decisions documented in the ROD for this proposal. Decisions by other jurisdictions to issue (or not to issue) approvals on to this proposal may be aided by the disclosure of impacts that is available in this analysis.

This EIS addresses the effects of developing CBM within the Project Area. It discloses built-in environmental protection measures applicable to all alternatives. It also proposes mitigation measures that apply to all or portions of the project area and to CBM development overall. Site-specific environmental protection measures are designed to control the impacts of the project.

Specific mitigation measures are also described in this EIS for individual wells where APDs and SUPOs are pending. These measures are designed to control or entirely mitigate localized environmental consequences associated with siting of a well.

The analysis evaluates specific proposed locations and proposed construction, operational, and decommissioning plans for components of the proposed action that are described in an APD, right-of-way (ROW) application, or special use permit (SUP) application. These plans apply to the wells, roads, pipelines, and ancillary facilities on federal mineral estate. Final locations for facilities will be confirmed as part of the normal processes for approving APDs, ROWs, or SUPs. The agencies' decisions made when the EIS process is complete will apply to construction, operation, and decommissioning of facilities that would involve impacts to federal lands and minerals.

## 1.5 Scope of Analysis for Well Sites

The 56 current pending APDs and SUPOs submitted by the companies in conjunction with their CBM gas field development plans are analyzed on a site-specific basis in this EIS (Figure 1–2). Decisions regarding these applications will be addressed in the ROD for this project.

The companies have not submitted APDs for all their proposed well sites within the Project Area to date. We project the companies to submit 30 to 40 APDs per year for their gas field development proposal. When submitted, the National Environmental Policy Act (NEPA) review of each of these APDs will be tiered to this EIS. The review will be limited in scope in each case to the site-specific aspects of the environmental analysis that were not covered by this EIS.

This will involve field review of specific well, access road, and flowline locations. The agencies will conduct site surveys consistent with specific requirements for protection of cultural and historical resources. These surveys also will evaluate compliance with the Endangered Species Act (ESA) and with the construction, operation, and mitigation requirements set forth in the ROD for this project proposal. The surface use requirements in Appendix A of the EIS will be modified as needed to address additional environmental concerns that may result from the field survey and final well and access road siting.

# 1.6 Context for Oil and Gas Leasing and Development

The BLM manages public lands, and FS administers national forests and national grasslands. The policies that control how these lands will be administered have their basis in a number of federal statutes. The sections below describe some of the important laws that apply to oil and gas development, and the regulations that codify the statues. Lease information pertinent to the Project Area is shown on Figure 1–3 and described in Appendix B.

## 1.6.1 Land and Resource Management Plans

The management plans for the San Juan Field Office of the BLM and San Juan National Forest (SJNF) both call for multiple use and sustained yield. The LRMP for the SJNF (FS 1983) provides long-range management direction for NFS lands in the Project Area. The LRMP also specifies the management requirements that set the baseline conditions that must be maintained and the mitigation measures that to apply to all area of the SJNF. Development of oil and gas must be consistent with the LRMP.

The RMP for the San Juan Field Office of the BLM serves the same purpose as the LRMP for the SJNF. It establishes management requirements and mitigation measures that apply to all areas under the jurisdiction of the Field Office. The RMP for the San Juan Field Office was approved in 1984, and the provisions of the plan on oil and gas leasing and development were amended in 1991. Management of BLM public lands within the Project Area must be consistent with the San Juan Resource Management Area RMP. This gas field development EIS is tiered to both the SJNF's LRMP and BLM's RMP.

## 1.6.2 Mineral Leasing Act

The 1920 Mineral Leasing Act (MLA), as amended, authorizes the Secretary of Interior to competitively lease the oil and gas resources on all public domain and acquired lands. The MLA implementing regulations are at 43 CFR 3100.

### 1.6.3 Federal Onshore Oil and Gas Leasing Reform Act

The Federal Onshore Oil and Gas Leasing Reform Act (Public Law (P.L.) 100–203) provides direction for each agency 1) to manage a leasing program for oil and gas and 2) to manage oil and gas operations on leases once they are issued. Oil and gas leasing and development are managed in a staged process that requires separate decisions at the leasing and development stages. This staged process is consistent with the staged decision making framework established for development and implementation of LRMPs and RMPs. The proposal under consideration in this environmental analysis is in the development stage.

The BLM manages all federally owned subsurface minerals. In the case of oil and gas on NFS lands, it is responsible for APD approval and for monitoring subsurface activities related to exploration and development. BLM's monitoring role includes administering all federal regulations that pertain to subsurface oil and gas, regardless of the agency that administers the surface resources. The BLM regulations are found in Title 43 CFR Part 3160.

The FS has the authority for and responsibility approving SUPOs prepared by the lessee, and ensuring that the requirements of the leases and operating plans are carried out according to their terms. The FS regulations are found in Title 36 CFR Part 228.

The required review of APDs and SUPOs provides the analytic basis that the decision maker(s) will use to establish the terms and conditions of approval for operations on the public lands and national forests. This decision is site specific or project level rather than programmatic and is the last of the staged decisions that constitute the process of oil and gas leasing and development on the BLM and NFS lands.

### 1.6.4 National Environmental Policy Act

The BLM and FS (joint lead agencies for this project) are required by NEPA and Council on Environmental Quality (CEQ) directives to analyze proposed actions that involve federal lands in terms of their potential impact on the human environment (40 CFR Parts 1500–1508). This EIS fulfills the requirements of NEPA and provides the responsible agency officials with information that can be used to base a final decision that is fully informed and that considers all factors relevant to the proposal. Public and agency scoping issues and concerns drive the development of alternatives and the impact analysis process. This EIS documents (1) the analysis of impacts that result from implementation of the proposed action and alternatives, and (2) the development of environmental protection measures necessary to reduce or eliminate environmental consequences.

Factors incorporated in the environmental analysis process for this proposed CBM project include the following:

- The location of well sites, access roads, pipelines, electrical distribution lines, compressor facilities, and produced water disposal facilities reflects an initial attempt to minimize impacts to surface resources and to meet needs of other resource activities while honoring the lease rights within the Project Area.

- The determination of impacts anticipated to result from implementation of the proposed action and alternatives is made in accordance with applicable regulations and lease stipulations, and mitigation measures necessary to avoid or minimize these impacts.

# 1.7 Status of Gas Field Development to Date

## 1.7.1 Development on the SJNF

To date, the companies have developed 31 wells on the SJNF, primarily in the Sauls Creek area of the HD Mountains, at a density of one well per 320-acre spacing unit. The BLM recently (May 2000) approved spacing of two wells per 320 acres on NFS lands within the La Plata County portion of the Project Area. Development of the Pargin Mountain area of the HD Mountains has been limited to five wells completed in 1992 and 1993.

## 1.7.2 Development on BLM Administered Public Land

The companies, to date, have developed 23 wells on BLM leases, most at a density of one well per 320-acre spacing unit. Seven wells have been developed at an increased well density of two wells per 320 acres. The BLM in May 2000 approved spacing of two wells per 320-acre spacing unit on most BLM leases in the Project Area.

## 1.7.3 Development on Private and State Land

Currently 231 wells are developed on private and state leases throughout the Project Area. About half of this development is at spacing of two wells per 320 acres, and the remainder is at one well per 320 acres. Private and state leases are subject to COGCC spacing order No. 112–157, which provides for development of the Fruitland Formation at a density of two wells per 320 acres.

# 1.8 Interim Criteria for CBM Development During the EIS Process

The BLM and FS have issued Interim Criteria as a Notice to Lessees to guide management of CBM production on public lands until completion of this NSJB CBM EIS. The interim criteria are intended to allow for limited development of mineral resources if it does not preclude options under the EIS. These guidelines also allow decision makers and technical staff to further study the effects of CBM development, especially with respect to seepage and water depletion issues. Environmental impacts are addressed on a case-by case basis in individual environmental analyses. Drilling in sensitive areas may be curtailed, and other areas may be subject to special stipulations and monitoring.

Within the Project Area, there are three regions that have established interim criteria. These regions include (1) the Fruitland Outcrop and a line 1½ miles basinward of the Fruitland Outcrop buffer north of the Southern Ute line (2), the area between the 1½ mile buffer zone and the northern line of the Southern Ute Reservation, and (3) the National Forest lands east of Bayfield. Criteria for each region are as follows:

- Fruitland Outcrop and buffer zone north of the Southern Ute line: No drilling within 1½ miles down basin from the outcrop until the NSJB EIS is completed, and a ROD on infill drilling can be supported within the EIS framework. Prior to this, the 3M modeling results (ground water study) will be available to support the ROD. (Exception: Drilling of monitoring and experimental wells will be allowed).
- Fruitland Outcrop and buffer zone south of the Southern Ute Reservation: Within this zone, the BLM will continue to process APDs on a case-by-case basis utilizing all available information, including the 3M modeling studies.
- National Forest lands east of Bayfield: Current NEPA documents address specific drilling windows on 320-acre spacing, but do not provide for infill drilling. The FS holds that, until the NSJB EIS is completed and a ROD issued, infill drilling will be delayed. However, existing 320-acre spacing units may be drilled.

The complete text of the Interim Criteria is included in Notice to Lessees (NTL) No. CO-SJFC-2000-01. The results of 3M modeling (the groundwater study) are incorporated in this EIS and the 3M Study along with other information disclosed n this EIS, will form the basis for the Record of Decision, continuing, or terminating, in whole or part, the CBM development direction presented by the Interim Criteria

## 1.9 Public Involvement

During 2000, the public had the opportunity to present issues and concerns regarding CBM development at forums sponsored by both the COGCC and La Plata County. These well-attended forums are considered key components of the overall public involvement strategy and the information presented at these forums was captured as critical public input to this project. Following the COGCC and La Plata County hearings, the BLM and FS conducted two rounds of informational open houses to build on the previous public involvement efforts and to present and receive information specific to the EIS for the NSJB.

Public scoping for this EIS formally began on April 4, 2000, after a Notice of Intent (NOI) to prepare an EIS was published in the *Federal Register*. The notice (volume 65, number 65, page 17,672) announced the BLM and FS intent to conduct an environmental analysis of CBM development in the NSJB of southwestern Colorado, and set May 16 and 17, 2000, as the dates for public meetings to solicit and receive comments on the proposed CBM development. The agencies published a second NOI in the *Federal Register* on June 9, 2000 (which appeared in volume 65, number 112, on page 36,713) that announced a change in dates for the public meetings from May 16 and 17, 2000, to June 28, 2000 in Durango, and June 29, 2000 in Bayfield. The notice also extended the deadline for submitting written comments from June 1, 2000, to July 14, 2000. Copies of both NOIs published are included as Appendix C.

The public meetings were structured to discuss the companies' proposed CBM development and to receive comments from the public. Meetings were conducted in the open house style, with representatives of the BLM, FS, La Plata County Planning Department, and the companies in attendance to provide handouts, answer questions, and solicit comments from the attendees.

During October 2001, the companies submitted a revised proposal that increased the number of CBM wells from 170 to approximately 300 new CBM wells. On January 16 and 17, 2002, a second round of public meetings was held in Durango and Bayfield to update the public on the revised proposed action and the alternatives to be described in the EIS. The overall scoping and issues compilation process generated 20 primary issue statements. Three of these statements concerned the need to develop effective mitigation measures, the geographic extent of the Project Area, and the need to address cumulative impacts of CBM development. These process issues are addressed by the purpose and scope of this EIS. The following environmental, social, and economic issues are addressed throughout the remainder of the EIS. Additional CBM development will affect:

(1) ground water resources, including aquifers and water wells,
(2) surface water resources,
(3) human health and safety,
(4) the socioeconomic environment,
(5) the area's geologic, paleontologic, and mineral resources,
(6) wildlife and fisheries and their habitats,
(7) agricultural and residential use,
(8) vegetation, including wetlands and riparian areas and old-growth ecosystems,
(9) the area's scenic values,
(10) air quality and visibility,
(11) area noise,
(12) transportation and roads,
(13) cultural resources and Native Americans,
(14) recreational opportunities,
(15) soils in and downstream of the Project Area,
(16) federal and state listed threatened, endangered, proposed, candidate, and sensitive species and their habitats,
(17) the HD inventoried roadless area and roadless lands in general.

# 1.10 Authorizing Actions

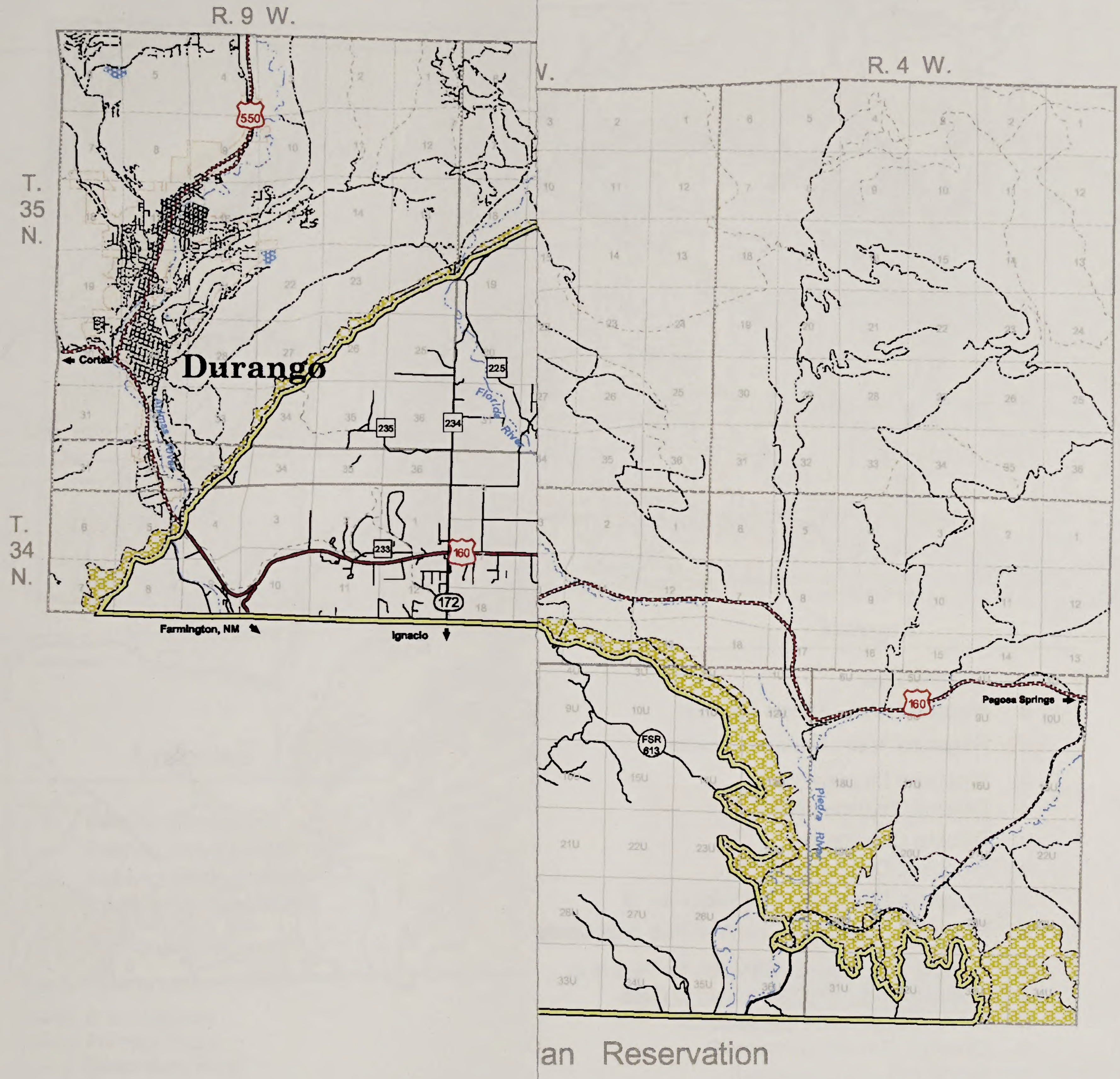
A variety of federal, state, county, and local permitting actions would be required to implement any of the alternatives. Table 1–1 lists the major federal and state permit, approvals, and consultations likely to be required for individual actions that are part of the NSJB CBM Project. However, the list is not necessarily conclusive. In addition, various county and local permitting and approval actions would be required for any alternatives selected by the decision maker(s).

## Table 1–1 Major Federal, State, and County Authorizing Actions

| Agency and Permit or Approval | Nature of Action | Authority |
|---|---|---|
| *Federal Permits, Approvals and Authorizing Actions* | | |
| *Bureau of Land Management* | | |
| Record of Decision for Preferred Alternative | Evaluates environmental impacts of Preferred Alternative. | National Environmental Policy Act of 1969, 42 USC 432.1 et seq. Council on Environmental Quality, 40 CFR 1501, 1502 |
| Application for Permit to Drill, Deepen, or Plug Back (APD) | Provides for compliance with regulations and requirements during the drilling and completion phase of the well. | Mineral Leasing Act of 1920 (30 USC 181 et seq.); Federal Oil and Gas Royalty Management Act of 1982, 43 CFR 3160 series, subparts 3160.0-1 Purpose, 3160.0-1 Authority, and 3161.1 Jurisdiction; Secretarial order NO. 3087, Amendment No. 1, February 7, 1983; Indian Mineral Development Act of 1982, 43 CFR 3160.0-3 |
| *U.S. Forest Service* | | |
| Record of Decision for Preferred Alternative | Evaluates environmental impacts of Preferred Alternative. | National Environmental Policy Act of 1969, 42 USC 432.1 et seq. Council on Environmental Quality, 40 CFR 1501, 1502 |
| Surface Use Plan of Operation | Occupancy or use of NFS leased lands in conjunction with all oil and gas operations. | Authority is Mineral Leasing Act as amended by the Federal onshore Oil and Gas Leasing Reform Act. |
| Special Use Permit | Surface disturbance on NFS lands. | |
| Special Use Permit (Cultural Resources) | Archaeological surveys and testing on NFS lands. Data recovery of sites on NFS lands. | |
| Timber Sales Contract | Accounts for timber, cut or affected during mineral-related activities. | National Forest Management Act of 1976. |
| *U.S. Fish and Wildlife Service* | | |
| Consultation process, endangered or threatened species | Reviews impact on federally listed and candidate threatened and endangered fish, wildlife, and plant species | Section 7 of the Endangered Species Act of 1973, as amended (16 USC Sec. 1344), 33 CFR 323, 325 |
| *Advisory Council on Historic Preservation* | | |
| Consultation on cultural and historic resources | Protects cultural and historic resources. Coordinated with the Colorado State Historic Preservation Officer (SHPO). | National Historic Preservation Act Section 106 and 36 CFR 800 |
| *U.S. Army Corps of Engineers* | | |
| Permit to Discharge Dredged or Fill Material (Section 404 Permit) | Authorizes placement of dredged or fill material in waters of the United States or adjacent wetlands. | Section 404, Clean Water Act, 40 CFR 122-123; 33 CFR 323 and 325 |
| *U.S. Environmental Protection Agency* | | |
| Permit to allow underground injection of produced water | Drilling of wells for the disposal of water produced from the CBM wells. | Safe Drinking Water Act, 40 CFR 144 and 147 |

## Table 1–1 Major Federal, State, and County Authorizing Actions

| Agency and Permit or Approval | Nature of Action | Authority |
|---|---|---|
| *U.S. Department of Transportation* | | |
| Sets standards for the construction and operation of natural gas pipelines | Prescribes minimum safety requirements for pipeline facilities and the transportation of gas. | 49 CFR 191 |
| *State Permits, Approvals and Authorizing Actions* | | |
| *Colorado State Historic Preservation Office* | | |
| Archaeological consultation | Archaeological Clearance. Programmatic agreement or consultation for cultural inventory, evaluation, and mitigation | National Historic Preservation Act Section 106 and 36 CFR 800 |
| *Colorado Department of Public Health and Environment* | | |
| Air Pollutant Emissions Notice and Construction/Operation Permit | Issue a permit that limits emissions from new or modified sources | CRS 25-7-110 et al. |
| Stormwater Permit | Issue a permit to regulate discharge of stormwater | Clean Water Act, 40 CFR 401; Colorado Water Quality Control Act 25-8-101 |
| *Colorado Department of Transportation* | | |
| Permit for oversize, overlength, and overweight loads | Transportation of equipment over state roads. | CRS 42-4-409 |
| Permit for right-of-way easement crossing state highways | Construction of new roads connecting to state roads. | CRS 43-1-105 |
| *Colorado Oil and Gas Conservation Commission* | | |
| Permit to Drill, Deepen, or Re-enter and Operate an Oil or Gas well | State approval for drilling on non-federal lands. | CRS 34-60 |
| *County Permits, Approvals and Authorizing Actions* | | |
| *La Plata County* | | |
| Permit for surface facilities | Issue a permit for surface facilities on private lands not connected with downhole operation | La Plata County land Development Code |
| Permit for overweight and overlength vehicles | Transportation of equipment over state roads. | La Plata County land Development Code |
| Permit for new roads crossing county roads | Construction of new roads connecting to state roads. | La Plata County land Development Code |
| *Archuleta County* | | |
| Conditional Use Application | Permit needed to construct major oil and gas facility. | Archuleta County Land Use Regulations, Section 11 and Appendices E and F |



## Legend

- Project Area Boundary
- U.S. Highway
- Primary Road
- Secondary Road
- Trail
- ■ Lake/Reservoir
- Stream/River
- ☐ Municipal Area
- ▨ Fruitland Formation Outcrop

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Study, 1998.
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NORTHERN SAN JUAN BASIN CBM EIS

**FIGURE 1-1**
**LOCATION OF THE PROJECT AREA**

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

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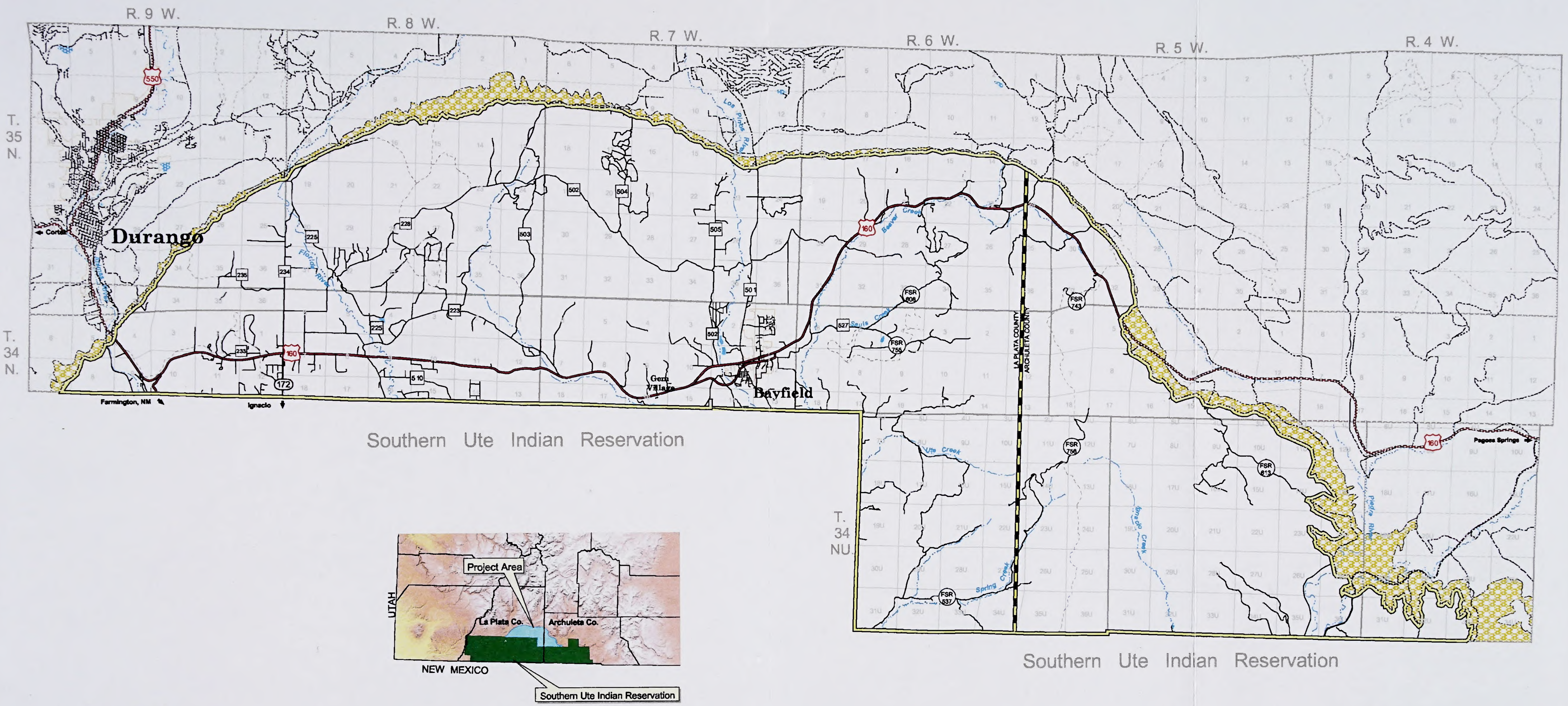
| | Prepared By: JG |



## Legend

- Project Area Boundary
- U.S. Highway
- Primary Road
- Secondary Road
- Trail
- 🟦 Lake/Reservoir
- Stream/River
- ⬜ Municipal Area
- ▨ Fruitland Formation Outcrop

N
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2 0 2 4 6 8 Kilometers

2 0 2 4 6 8 Miles

*La Plata County transportation data provided by the La Plata County Transportation Study, 1998. Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data.*

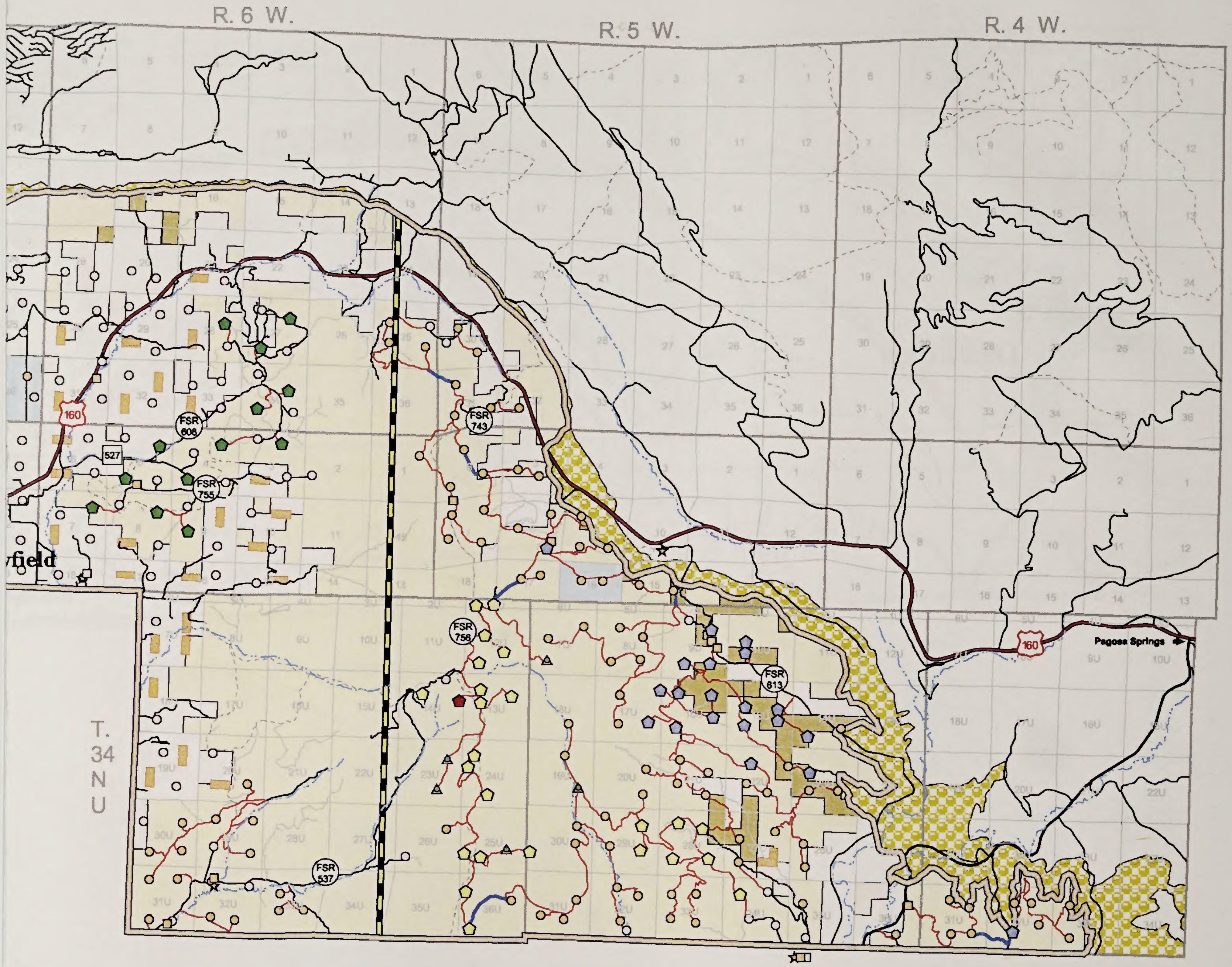
*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

NORTHERN SAN JUAN BASIN CBM EIS

### *FIGURE 1-1*
### *LOCATION OF THE PROJECT AREA*

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

| | |
|---|---|
| Date: 04/01/04 | ArcView File: C:\994-sanjuan\proj1.apr |
| | Prepared By: JG |



*La Plata County transportation data provided by the La Plata County Transportation Study, 1998. Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data. Existing wells extracted from COGCC well database and edited by the BLM & USFS.*

***Kilometers***

***6 8 Miles***

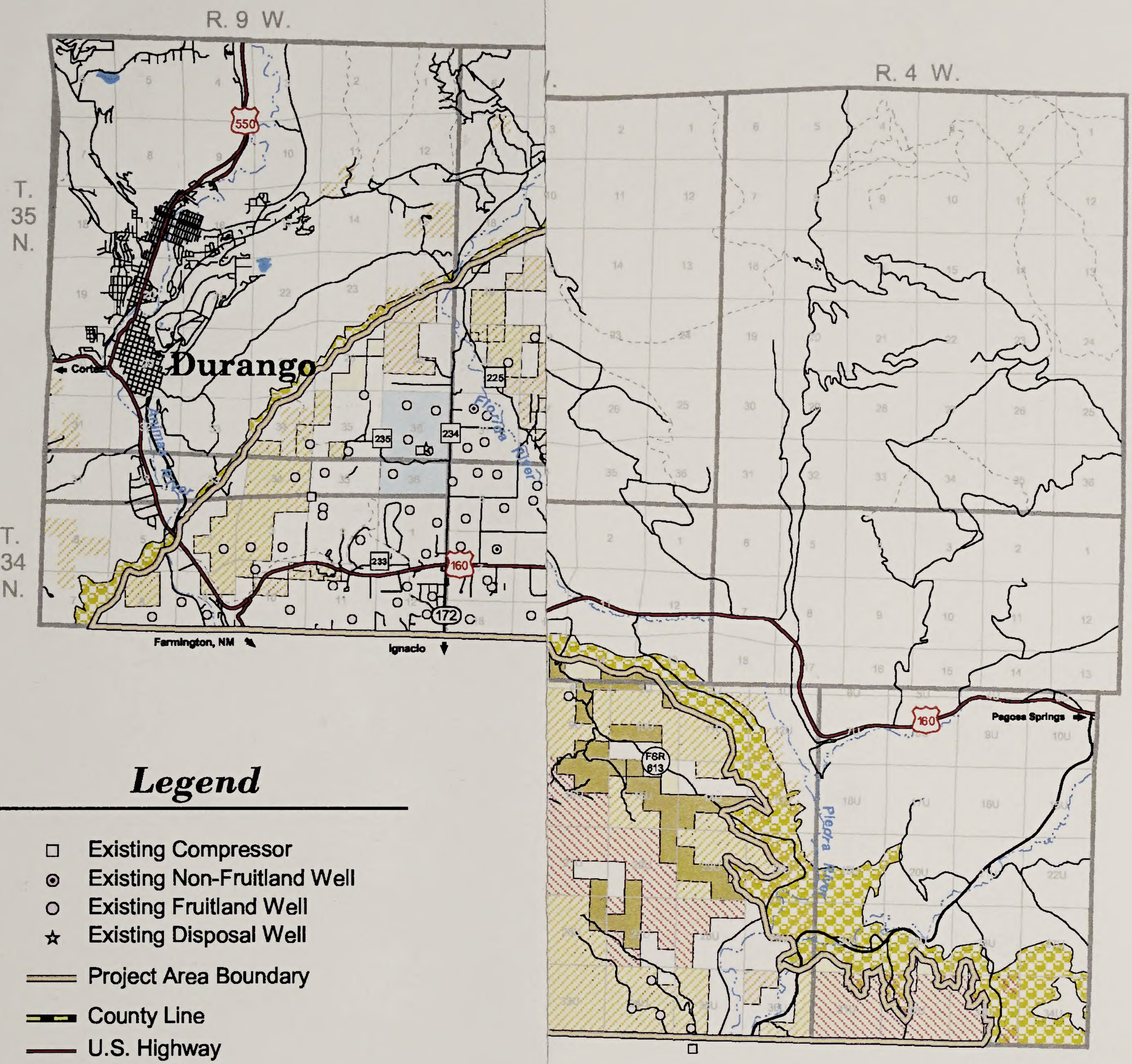
*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

NORTHERN SAN JUAN BASIN CBM EIS

**FIGURE 1-2**
**APPLICATION FOR PERMIT TO DRILL OR NOTICE OF STAKING LOCATIONS RECEIVED TO DATE & PROPOSED ACTION**

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

Date: 04/01/04
ArcView File: C:\994-sanjuan\proposal.apr
Prepared By: JG



## Legend

- □ Existing Compressor
- ⊙ Existing Non-Fruitland Well
- ○ Existing Fruitland Well
- ☆ Existing Disposal Well
- Project Area Boundary
- County Line
- U.S. Highway
- Primary Road
- Secondary Road
- Trail
- Lake/Reservoir
- Stream/River
- Fruitland Formation Outcrop

Federal Leases as of April 23, 2003

- ▨ Federal Lease
- ▨ Federal Lease With No Surface Occupancy Sti
- ▨ Federal Lease in Roadless Area - Post 01/12/2
  With No Surface Occupancy Stipulations

Surface/Mineral Ownership

- Federal Surface/Federal Mineral
- Federal Surface/Private Mineral
- Private Surface/Private Mineral
- Private Surface/Federal Mineral
- State Surface/State Mineral

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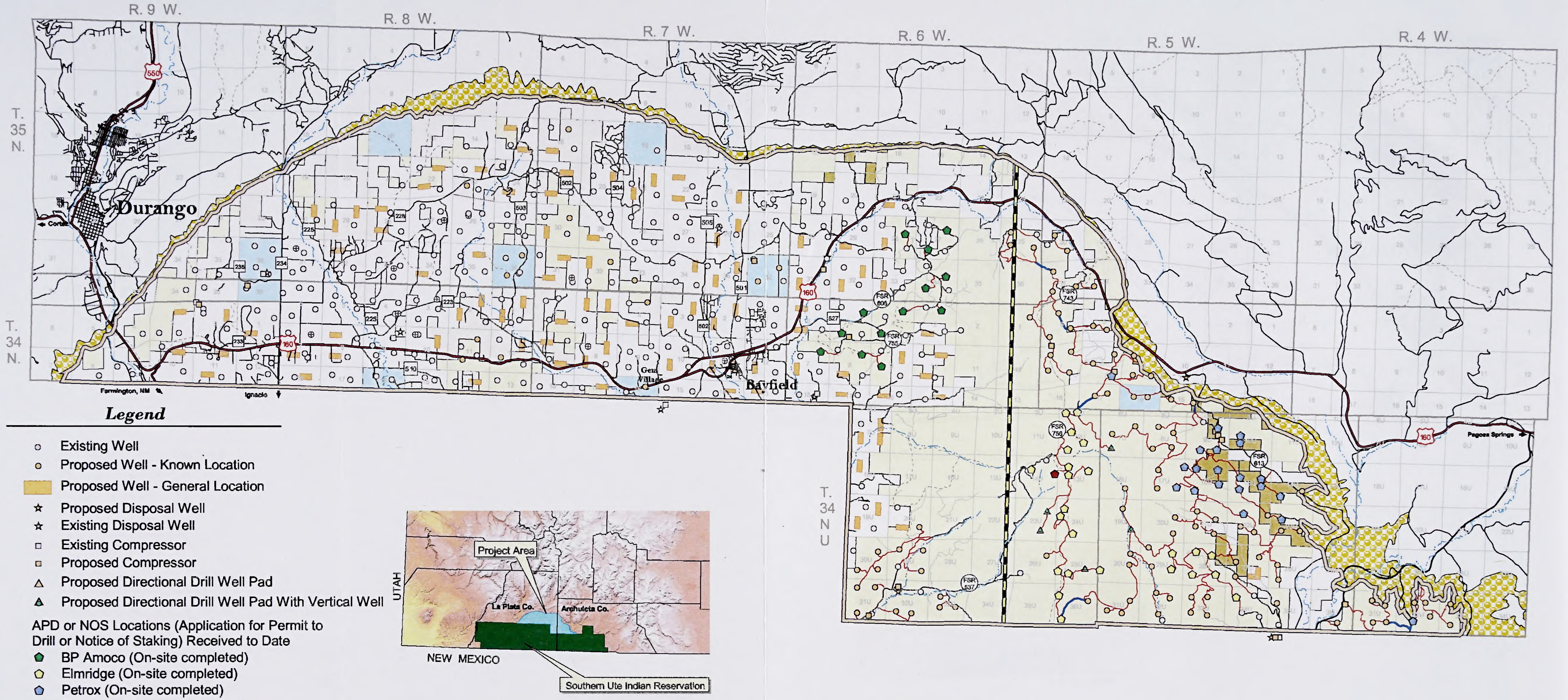
*FS.*

NORTHERN SAN JUAN BASIN CBM EIS

### FIGURE 1-3
### PROJECT AREA LEASE STATUS

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

| | |
|---|---|
| Date: 04/01/04 | ArcView File: C:\994-sanjuan\proj1.apr |
| | Prepared By: JG |



## Legend

○ Existing Well
○ Proposed Well - Known Location
▭ Proposed Well - General Location
☆ Proposed Disposal Well
★ Existing Disposal Well
□ Existing Compressor
□ Proposed Compressor
△ Proposed Directional Drill Well Pad
▲ Proposed Directional Drill Well Pad With Vertical Well

APD or NOS Locations (Application for Permit to Drill or Notice of Staking) Received to Date
⬟ BP Amoco (On-site completed)
⬠ Elmridge (On-site completed)
⬟ Petrox (On-site completed)
⬟ Elmridge (Still Needs On-Site)

— Proposed Flowline
— Proposed Access Road/Flowline
═ Project Area Boundary
— U.S. Highway
— Primary Road
— Secondary Road
— Closed USFS Road
---- Trail
-·-·- River/Stream

Surface Ownership/Mineral Ownership
▭ Federal/Federal
▭ Federal/Private
▭ Private/Private
▭ Private/Federal
▭ State/State
▨ Fruitland Outcrop

N
W E
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2 0 2 4 6 8 Kilometers

2 0 2 4 6 8 Miles

*La Plata County transportation data provided by the La Plata County Transportation Study, 1998. Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data. Existing wells extracted from COGCC well database and edited by the BLM & USFS.*

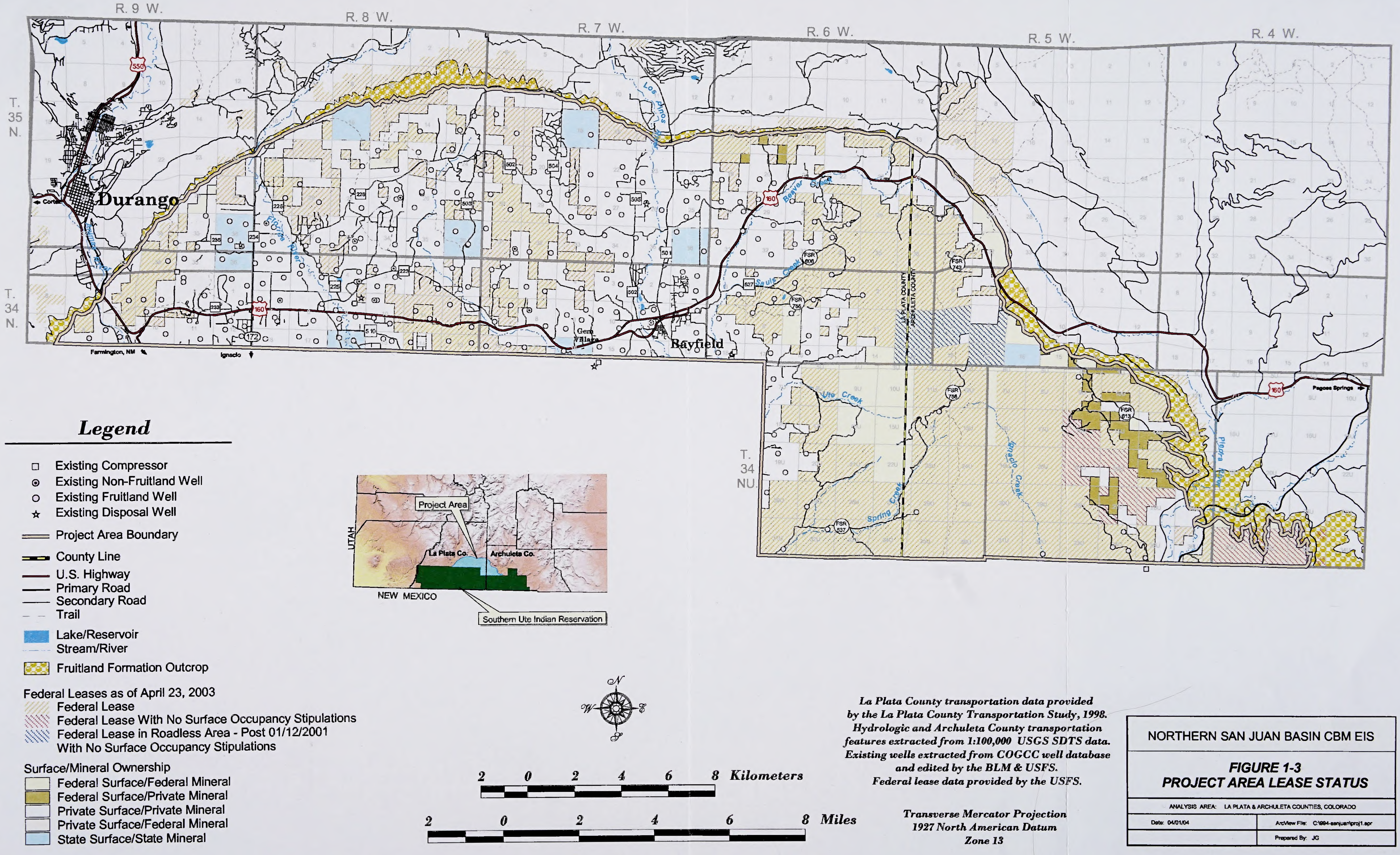
*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

NORTHERN SAN JUAN BASIN CBM EIS

**FIGURE 1-2**
**APPLICATION FOR PERMIT TO DRILL OR NOTICE OF STAKING LOCATIONS RECEIVED TO DATE & PROPOSED ACTION**

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

Date: 04/01/04
ArcView File: C:\994-sanjuan\proposal.apr
Prepared By: JG



*La Plata County transportation data provided by the La Plata County Transportation Study, 1998. Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data. Existing wells extracted from COGCC well database and edited by the BLM & USFS. Federal lease data provided by the USFS.*

*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

NORTHERN SAN JUAN BASIN CBM EIS

***FIGURE 1-3***
***PROJECT AREA LEASE STATUS***

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

Date: 04/01/04
ArcView File: C:\694-sanjuan\proj1.apr
Prepared By: JG

# Chapter 2

# Proposed Action and Alternatives

# Chapter 2 — Proposed Action and Alternatives

This chapter presents seven alternatives formulated to respond to the companies proposed action and to public scoping issues. The chapter is divided into six major sections:

- Background information key to understanding the alternatives.
- Process used to develop the alternatives.
- Alternatives analyzed in detail.
- Alternatives dismissed from detailed consideration.
- Well field development activities common to the alternatives.
- Comparative analysis of environmental consequences of the alternatives.

## 2.1 Background Information Key to Understanding the Alternatives

This section discusses well spacing orders and drilling methods that are key to understanding all alternatives. It also reviews the assumptions used in analyzing the alternatives.

### 2.1.1 Well Spacing Orders

BLM (May 3, 2000) and COGCC (Order No. 112–156) issued orders in 2000 that effectively increased the permissible densities of wells by amending previous orders that allowed one well per 320-acre spacing unit. These new orders allow two wells per 320-acre spacing unit for the coal seam in the Fruitland Formation in the La Plata County portion of the Project Area. This well density promotes optimum drainage and recovery of the natural gas resource in the western portion of the Project Area.

The orders also define boundaries and setbacks within each quarter section, which appear as windows of about 27 acres when they are delineated on a map. Wells are situated within the windows to provide adequate spacing between wells and to promote efficient drainage of the gas field.

Current spacing in Archuleta County remains one well per 320-acre unit. The companies propose to unitize leases (a method of coordinated development aimed at protecting drainage of the resource) within Archuleta County in the eastern portion of the Project Area. The unitized leases could allow for up four wells per section at some point in development of the gas field if this density of wells is deemed optimum from a drainage standpoint.

Open, undrilled drilling windows, especially in the western portion in the Project Area, can encompass both private and federal ownership. Thus, the option exists for the companies to situate a well on either private or federal surface ownership within the 27-acre drilling window. A total of 24 drilling windows encompass lands with some combination of federal and private ownership where the actual location of a well within the 27-acre window has not been selected at this time. These wells would be sited at the time that a company submits an APD.

## 2.1.2 Alternative Drilling Methods

Alternative drilling methods considered in this EIS include directional and horizontal methods. Directional drilling is typically used when terrain features or fragile resources prevent or discourage a company from occupying the surface directly above the target downhole location. When the companies drill directionally, they move to another location and drill back at an angle, instead of vertically, underground to the target area. Thus, the surface well is offset from the downhole target.

Alternatives 1 and 2 both utilize directional drilling. Directional drilling is feasible in areas where there is sufficient distance between the surface location and subsurface target to accommodate the necessary well bore curvature. Directional drilling deviation from vertical is typically 20-22 degrees and requires at least the first 300 feet of depth to be drilled vertically to accommodate the surface casing. An angle of 20 degrees of departure allow for thirty-five feet of offset for each 100 feet of depth drilled. Directional drilling is thought to be technically and economically feasible in the highest elevations of the HD Mountains because the distance between the ground surface and the target Fruitland Formation (4,000 feet) is sufficient to allow offsets from surface locations to targeted subsurface locations in the coal reservoirs. Directional drilling has been considered at locations other than the crest of the HD's within the Project Area, but does not appear feasible because of lack of depth to the target Fruitland Formation. Figure 2–1 displays distance from surface to Fruitland coals.

Horizontal drilling is a subset of the more general term "directional drilling" used where the departure of the well bore from vertical exceeds about 80 degrees. Horizontal drilling can be utilized in situations where the depth to coals is not sufficient to allow conventional directional drilling. Short-reach horizontal drilling provides maximum horizontal displacement of 1,800 feet from wellhead and long-reach horizontal drilling provides a maximum horizontal displacement of about 3,600 feet from wellhead. Both drilling approaches are considered in the formulation of alternatives. These two methods of drilling present different ways to implement the companies' proposed action. Horizontal drilling has seen limited application in the San Juan Basin (SJB) to date and has met with mixed success. The drilling method is examined in the EIS as a way to reduce surface impacts if its effectiveness is demonstrated in the Fruitland coals. Appendix D provides a more comprehensive description of the drilling technologies and their use in the SJB.

### 2.1.3 Assumptions Used in Analyzing the Alternatives

The alternatives present both specific proposed well locations and 27-acre drilling windows where the exact locations of the wells have not been identified through field siting. Surface and mineral ownership are identified where well locations are known within the drilling windows. The well is assigned a jurisdiction where the well location is not known but is within a drilling window that encompasses more than one jurisdiction by using the geographic center of the window as the assumed location.

Assumptions are made about the amount of road construction required to access windows where precise well locations have not been established. In the western portion of the Project Area, the assumed lengths of access road and pipelines needed to access each well pad is ¼ mile for private and state-owned lands, ⅓ mile for lands administered by BLM, and ½ mile for NFS lands (Bell 2002). A conceptual network of roads has been laid out and more precisely measured in the eastern portion of the Project Area. The access roads and gathering pipelines for gas and produced water would require a 40-foot cleared ROW during construction and a 25-foot cleared ROW after partial reclamation after construction.

### 2.1.4 Project Area and Cumulative Effects Area

The alternatives are framed around the analysis of gas development on all jurisdictions within the Project Area. Allowing development of federal oil and gas leases constitutes the federal action, which is the subject of agency decision-making in this EIS. The federal government has no regulatory influence over how and when CBM development proceeds on private and state leases within the project area, but analyzes foreseeable development of these lands for the purpose of environmental consequences analysis. The 125,000-acre study area is treated as a single comprehensive project from which the direct and indirect effects of development are evaluated.

A larger cumulative effects area is also investigated in response to local and federal agency concerns and public scoping. This area, described in detail in Chapter 3, encompasses the Colorado portion of the SJB. The analysis area considers, in addition to the Project Area, projected conventional and CBM gas development within the bounds of the Southern Ute Reservation. Further, the air, water quality and social and economic impacts are more far reaching. Their analyses extend into New Mexico, addressing energy development within the SJB proper, including development within the BLM Farmington Resource Area and Jicarilla Ranger District, Carson National Forest.

## 2.2 Process Used to Develop Alternatives

The alternatives to the proposed action were designed to respond to issues identified through scoping. The no-action alternative is required under 40 CFR 1502.14. The alternatives cover development possibilities that range from no development on federal oil and gas leases to maximum development of all leased lands within the Project Area.

A number of alternatives have also been eliminated from detailed consideration. These alternatives and the rationale for their exclusion are discussed in Section 2.3 (beginning on page 2–19).

Seven alternatives are analyzed in detail. Thematically they represent the Proposed Action (Alternative 1), BLM and FS modifications of the Proposed Action (Alternatives 1A thru 4), and the No Action Alternative (Alternative 5). Each of the alternatives considers the federal action, which is development of federal oil and gas leases within the Project Area, and development on all jurisdictions, including private and state leases within the Project Area.

Alternatives 1A and 1B are sub-alternatives that implement the Proposed Action, but do so by including directional and horizontal drilling methods to reduce the Proposed Action's surface impacts. Actions under these two alternatives would include siting multiple wells on some well pads. These wells would drain the same lease areas as single wells on all well pads under Alternative 1.

## 2.2.1 Alternative 1 — Proposed Action

Alternative 1 is the companies' CBM development proposal. The federal action that is the subject of federal decision-making under Alternative 1 would be to allow environmentally sound drilling of and subsequent production from 197 wells located on 174 well pads on federal oil and gas leases in the Project Area.

Comprehensively, Alternative 1 includes the companies drilling 296 new CBM wells on 273 well pads on all jurisdictions within the Project Area and constructing the ancillary facilities needed to support these wells (Table 2–1). These facilities include access roads; pipelines for gathering gas and produced water; electric facilities; facilities for measuring and compressing gas; and facilities for treating, containing, and disposing of produced water using deep underground injection or possibly surface discharge.

The gas field would be developed with a density of four wells per section throughout most of the Project Area.

The companies propose to directionally drill 25 wells in the high elevation portion of the HD Mountains (Figure 2–2). Well pads for directional drilling are larger than well pads for single vertical wells. The 15 multi-well pads that would be needed for directional wells under Alternative 1 are located in the eastern half of T34N, R6W.

The companies also propose to construct an estimated 100 miles of collocated access roads and gathering lines, up to seven disposal wells, 14 compressors units on 11 new sites, and approximately 17 miles of gas trunk line within the Project Area. Trunk lines transport gas from the compressors to the transmission pipelines. Ancillary facilities by jurisdiction and the amount of direct surface disturbance for this alternative are presented on Table 2–1.

**Table 2–1 Summary of Proposed Wells and Ancillary Facilities under Alternative 1 — The Proposed Action**

| | | Direct Ground Disturbance[1] | |
|---|---|---|---|
| Facility | Number | Short term (acres) | Long term (acres) |
| CBM Wells | | | |
| **BLM Lands** | **12** | **NA[2]** | **NA** |
| **National Forest System Lands** | **185** | **NA** | **NA** |
| State Lands | 7 | NA | NA |
| Private Lands | 92 | NA | NA |
| Total | 296 | NA | NA |
| CBM Well Pads | | | |
| **BLM Lands** | **12** | **17** | **12** |
| **National Forest System Lands** | **162** | **235** | **170** |
| State Lands | 7 | 10 | 7 |
| Private Lands | 92 | 129 | 92 |
| Total | 273 | 390 | 281 |
| Roads/Pipelines (total length in miles) | | | |
| **BLM Lands** | **3** | **14** | **9** |
| **National Forest System Lands** | **92** | **445** | **278** |
| State Lands | 1 | 6 | 4 |
| Private Lands | 22 | 109 | 68 |
| Total | 118 | 574 | 359 |
| Pipelines (total length in miles)[3] | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **4** | **19** | **0** |
| State Lands | 0 | 0 | 0 |
| Private Lands | <1 | 1 | 0 |
| Total | 4 | 20 | 0 |
| Produced Water Disposal Wells | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **1** | **2** | **2** |
| State Lands | 0 | 0 | 0 |
| Private Lands | 0 | 0 | 0 |
| Outside the Project Area | 2 | 4 | 3 |
| Undetermined Location | 4 | 8 | 6 |
| Total | 7 | 14 | 11 |
| Trunk Pipelines | | | |
| Undetermined Location | 17 | 82 | 0 |
| Total (total length in miles) | 17 | 82 | 0 |
| Compressors | | | |
| Stations | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **9** | **21** | **21** |
| State Lands | 2 | 6 | 6 |
| Private Lands[4] | 2 | 3 | 3 |
| Outside Project Area | 1 | 3 | 3 |
| Undetermined Locations | 0 | 0 | 0 |
| Total | 14 | 33 | 33 |
| Total Horsepower | 42,500 | NA[4] | NA |
| Total Disturbance | NA | 1,113 | 684 |

Notes:

1. Totals may not match precisely with values obtained by adding unit numbers based on rounding conventions.
2. NA = Not applicable.
3. Pipelines not associated with roads
4. Two proposed stations are located on existing stations and are therefore not included in this disturbance.

Sources: Bell 2001, FS and BLM 2003.

The companies operating in the eastern portion of the Project Area propose to dispose of produced water though a combination of truck hauling and deep injection at disposal wells. As many as four disposal sites may be constructed, as shown in Figure 2–2. The companies in the western portion of the Project Area have evaluated three options for disposing of produced water. XTO Energy may drill a new disposal well in the Project Area, but has not selected a specific location. BP America plans to drill one additional disposal well in the Project Area but has not identified a location. Outside of the Project Area, BP has acquired a permit for one new disposal well and is pursuing a permit for a second new well. The added disposal wells would have the capacity to handle approximately 8,000 to 10,000 barrels of additional water per day.

New gas compression facilities would consist of 33 natural gas-fired compressor units distributed across 14 compressor stations. Multiple compressor units may be located at one compressor station. The 14 new compressor sites would add 42,500 horsepower of compression to the Project Area (Table 2–2).

**Table 2–2 Additional Compression Required for Alternative 1**

| Legal Description | Jurisdiction | Surface Disturbance (Acres) | Horsepower |
|---|---|---|---|
| Eastern Project Area Compression | | | |
| Section 3, T33NU, R5W (Outside the Project Area) | Private | 3 | 5,000 |
| Section 31U, T34NU, R6W | NFS | 3 | 3,000 |
| Section 36U, T34NU, R5W | NFS | 3 | 620 |
| Section 9U, T34N, R5W (3 compressor stations) | NFS | 3 | 1,860 |
| Section 5, T34N, R6W | NFS | 3 | 4,000 |
| Section 32U, T34NU, R6W | NFS | 3 | 18,000 |
| Section 8, T34N, R5W | NFS | 3 | 620 |
| Section 7, T34N, R5W | NFS | 3 | 620 |
| Western Project Area Compression | | | |
| Section 36, T35N, R9W[1] | State | 0 | 1,500 |
| Section 2, T34N, R9W | Private | 3 | 240 |
| Section 31, T35N, R6W | Private | 3 | 3,000 |
| Section 36, T34N, R9W | State | 3 | 4,000 |
| Total Number of Compressor Stations | 14 | 33 | 42,500 |

Note:

1. These compressors would be installed at existing compressor stations. Thus, no new surface disturbance would occur.

Source: Brown 2001, 2002

The overall life of the project, including construction, production, and reclamation, would be approximately 40 years. Well construction would begin during 2004 and would continue for 5 years. The productive life of each well is expected to be about 25 to 30 years. Accordingly, production from the wells drilled at the end of the 5-year drilling period would conclude by 2039. Final reclamation of each well would take place during the 2 to 3 years immediately after the end of its productive life. Thus, the project would be completed by approximately 2042.

Electricity may be used for several aspects of the project. If it is available, the Companies may use electricity during well development and to initiate and maintain production. They also may use electric-powered compressors in lieu of gas-fired compressors where electricity is available.

## 2.2.2 Alternatives 1A and 1B — Reduced Surface Disturbance

These two BLM and FS developed sub-alternatives are designed to drain the same federal lease area as the companies' proposal, but in a manner that reduces the Proposed Action's surface impact by promoting drilling of multiple wells from a single well pad. The two alternatives analyze directional, short-reach, and long-reach horizontal drilling within portions of the Project Area to reduce the number and surface area of well pads and ancillary facilities and the miles of access road on federal oil and gas leases.

Alternatives 1A and 1B explore how the gas field could be developed if directional and horizontal drilling technology is used to the maximum extent. In practical terms, the technologies can be applied to any of the alternatives considered in detail. They would be considered on an APD-by-APD basis as the gas field in the Fruitland formation continues to infill and after the drilling approaches have been further tested and refined in the SJB.

For Alternatives 1A and 1B, well pad densities may vary across the planning area; the objective would be to manage lease development so as to limit surface density consistent with lease rights granted.

## 2.2.3 Alternative 1A — BLM/FS Preferred Alternative

Alternative 1A is the BLM and FS Preferred Alternative. Alternative 1A modifies the proposed action to mitigate and/or reduce direct surface impacts through well siting measures that consolidate and collocate facilities to reduce surface well density in certain portions of the planning area. Specifically, it is estimated that 62 well pads and associated 24 miles of road would be eliminated from the companies' proposal. This would require consolidating drilling operations onto identified well pads (Figure 2–3) based upon site-specific considerations, technically feasibility and consistency with the lease rights granted. The federal action involves permitting activities to allow the companies to develop 184 wells from 112 well pads on federal mineral estate.

Comprehensively, Alternative 1A includes a total of 283 wells that would be drilled from 211 well pads across all jurisdictions within the Project Area. Thus, access to the reservoir from some of the identified Federal well pads would be through directional drilling, which by definition includes a variety of different well bore configurations including horizontal wells. This alternative is designed to provide a surface location for a drill rig that is horizontally, no more than 1,800 feet from the permitted bottom hole location in the reservoir.

Limiting this horizontal distance to 1,800 feet is predicated upon a number of factors including depth to the reservoir, reservoir and rock properties, and the technical and economic feasibility of various directional-drilling techniques. There are however, two predominate factors supporting this horizontal limit.

First, it is anticipated that a number of the directional-drilled wells will use an "S" shaped well bore trajectory whereby the well bore path builds to a certain angle then drops vertically back into the reservoir. Extensive directional drilling experience in the Piceance Basin has demonstrated that the horizontal distance from the surface location is limited to between 1,500 feet and 2,000 feet, otherwise excessive drilling problems, such as key-seating, occur due to excessive angles within the well bore.

The second factor supporting the 1,800-foot horizontal offset is based upon the results of recently drilled short reach horizontal wells in northern New Mexico. Four wells have been drilled in the SJB using short reach horizontal drilling, with the economic, reservoir and rock properties limiting the maximum horizontal length in the reservoir to 1,800 feet. Industry is monitoring production rates, issues regarding stability of well bores within the target formation, and the overall financial efficiency of short-reach horizontal drilling and is refining their drilling approach. The drilling method is considered investigational in the SJB at this time.

Functionally, an average of two to three well pads access four target bottom hole locations per section using either various shaped directional-drilled wells, or short reach horizontal drilling. The difference in the number of well pads and miles of road between Alternatives 1 and 1A is illustrated by comparing Table 2–1 to Table 2–3. Consolidation of drilling activities onto identified well pads will reduce surface impacts, but limiting the horizontal offset to 1,800 feet would still require access roads to almost all square-mile sections throughout the Project Area. There may also be cases where requiring consolidation of drilling operations onto identified well pads will not be consistent with the lease rights granted (see 43 CFR 3101.1–2) and thus, not implementable.

## 2.2.4 Alternative 1B

Alternative 1B modifies the proposed action to reduce surface impact through well siting measures that consolidate and collocate facilities to reduce surface well density through certain portions of the planning area. Specifically it is estimated that Alternative 1B eliminates 115 well pads and 56 miles of road from the Proposed Action. This would require drilling operations to be consolidated onto identified well pads based upon site-specific considerations, technically feasibility and consistency with the lease rights granted. The federal action involves permitting the development of 135 horizontal well legs from 62 well pad locations.

## Table 2–3 Summary of Wells and Ancillary Facilities Required for Alternative 1A

| | | Direct Ground Disturbance[1] | |
|---|---|---|---|
| Facility | Number | Short term (acres) | Long term (acres) |
| CBM Wells | | | |
| **BLM Lands** | **12** | **NA[2]** | **NA** |
| **National Forest System Lands** | **172** | **NA** | **NA** |
| State Lands | 7 | NA | NA |
| Private Lands | 92 | NA | NA |
| Total | 283 | NA | NA |
| CBM Well Pads | | | |
| **BLM Lands** | **12** | **17** | **12** |
| **National Forest System Lands** | **100** | **201** | **189** |
| State Lands | 7 | 10 | 7 |
| Private Lands | 92 | 129 | 93 |
| Total | 211 | 357 | 301 |
| Roads/Pipelines (total length in miles) | | | |
| **BLM Lands** | **3** | **14** | **9** |
| **National Forest System Lands** | **68** | **329** | **205** |
| State Lands | 1 | 6 | 4 |
| Private Lands | 22 | 108 | 68 |
| Total | 94 | 457 | 286 |
| Pipelines (total length in miles)[3] | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **5** | **24** | **0** |
| State Lands | 0 | 0 | 0 |
| Private Lands | < 1 | < 1 | 0 |
| Total | 5 | 24 | 0 |
| Produced Water Disposal Wells | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **0** | **0** | **0** |
| State Lands | 0 | 0 | 0 |
| Private Lands | 0 | 0 | 0 |
| Outside the Project Area | 2 | 4 | 3 |
| Undetermined Location | 4 | 8 | 7 |
| Total | 6 | 12 | 10 |
| Trunk Pipelines | | | |
| Undetermined Location | 17 | 82 | 0 |
| Total (total length in miles) | 17 | 82 | 0 |
| Compressors | | | |
| Stations | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **9** | **21** | **21** |
| State Lands | 2 | 6 | 6 |
| Private Lands[4] | 2 | 3 | 3 |
| Outside Project Area | 1 | 3 | 3 |
| Undetermined Locations | 0 | 0 | 0 |
| Total | 14 | 33 | 33 |
| Total Horsepower | 42,500 | NA[4] | NA |
| Total Disturbance | NA | 965 | 630 |

Notes:

1. Totals may not match precisely with values obtained by adding unit numbers based on rounding conventions.
2. NA = Not applicable.
3. Pipelines not associated with roads
4. Two proposed stations are located on existing stations and are therefore not included in this disturbance.

Sources: Bell 2001, FS and BLM 2003.

Comprehensively, Alternative 1B includes a total of 231 wells on 158 well pads on all jurisdictions within the Project Area. Thus, access to the reservoir from some of the identified Federal well pads will be through directional drilling, which by definition includes a variety of different well bore configurations including up to horizontal wells. The estimated horizontal distance from well pad to the permitted bottom hole location in the reservoir is approximately 3,600 feet. Based upon recent drilling tests in La Plata County which have similar horizontal offset distances, long reach horizontal drilling would be required since other directional drilling well bore configurations are not technically, or economically feasible due to the relatively shallow depth of the reservoir.

Long-reach horizontal drilling entails constructing a single well pad of approximately 4 acres that would be used to drill up to four single-bore, long-reach wells. On average, each well pad provides a surface location for development of 1,280 acres of the reservoir. The difference in number of well pads and miles of access road between Alternatives 1 and 1B is illustrated by comparing Table 2–1 to Table 2–4.

Long-reach horizontal drilling would be used across the relatively undeveloped portions of the HD Mountains, where impacts would be mitigated through consolidation of drilling operations onto identified well pads. The locations of the well pads are dictated by constraints on road access and by the objective of promoting effective reservoir management. Figure 2–4 depicts how Alternative 1B could be applied to the companies' proposed action.

Long-reach horizontal drilling has undergone limited testing in the SJB. Tests of this technology in the Fruitland Formation coals are currently limited to two wells in La Plata County that have been producing for two years. Drilling and production companies are monitoring well production rates, costs, reliability of the well bore, and the financial efficiency of the approach. Operational issues have led to further refinement and monitoring of the drilling approach. The application of this technology within the SJB to field development would hinge on the continued success of the approach. Thus, the drilling method is still considered investigational in the SJB at this time. There may also be cases where requiring consolidation of drilling operations onto identified well pads will not be consistent with the lease rights granted (see 43 CFR 3101.1–2) and thus, not implementable.

## 2.2.5 Alternative 2

Alternative 2 is developed specifically to address the assumption that the demand and price for natural gas would significantly increase in the future, triggering further development of CBM. As such, the alternative is based on the assumption that the companies would seek to develop wells to a density of four per section throughout most of the entire Project Area. Alternative 2 differs from Alternative 1 only in scale. Thus, the following description focuses on aspects of Alternative 2 that differ from Alternative 1. Figure 2–5 shows the distribution of drilling windows and wells projected under this alternative.

## Table 2–4 Summary of Wells and Ancillary Facilities Required for Alternative 1B

| | | Direct Ground Disturbance[1] | |
|---|---|---|---|
| Facility | Number | Short term (acres) | Long term (acres) |
| CBM Wells | | | |
| **BLM Lands** | **12** | **NA[2]** | **NA** |
| **National Forest System Lands** | **123** | **NA** | **NA** |
| State Lands | 5 | NA | NA |
| Private Lands | 91 | NA | NA |
| Total | 231 | NA | NA |
| CBM Well Pads | | | |
| **BLM Lands** | **12** | **17** | **12** |
| **National Forest System Lands** | **50** | **157** | **154** |
| State Lands | 5 | 5 | 5 |
| Private Lands | 91 | 91 | 91 |
| Total | 158 | 270 | 262 |
| Roads/Pipelines (total length in miles) | | | |
| **BLM Lands** | **3** | **14** | **9** |
| **National Forest System Lands** | **38** | **184** | **115** |
| State Lands | 0 | 0 | 0 |
| Private Lands | 21 | 103 | 65 |
| Total | 62 | 302 | 189 |
| Pipelines (total length in miles)[3] | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **0** | **0** | **0** |
| State Lands | 0 | 0 | 0 |
| Private Lands | 0 | 0 | 0 |
| Total | 0 | 0 | 0 |
| Produced Water Disposal Wells | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **1** | **2** | **2** |
| State Lands | 0 | 0 | 0 |
| Private Lands | 0 | 0 | 0 |
| Outside the Project Area | 2 | 4 | 3 |
| Undetermined Location | 4 | 8 | 6 |
| Total | 7 | 14 | 11 |
| Trunk Pipelines | | | |
| Undetermined Location | 17 | 82 | 0 |
| Total (total length in miles) | 17 | 82 | 0 |
| Compressors | | | |
| Stations | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **3** | **9** | **9** |
| State Lands | 2 | 3 | 3 |
| Private Lands[4] | 2 | 6 | 6 |
| Outside Project Area | 0 | 0 | 0 |
| Undetermined Locations | 0 | 0 | 0 |
| Total | 7 | 18 | 18 |
| Total Horsepower | 42,500 | NA | NA |
| Automated Central Gathering Station | | | |
| **BLM** | **0** | **0** | **0** |
| **Nation Forest System Lands** | **4** | **4** | **4** |
| State Lands | 0 | 0 | 0 |
| Private Lands | 0 | 0 | 0 |
| Total | 4 | 4 | 4 |
| Total Disturbance | NA | 690 | 484 |

Notes:

1. Totals may not match precisely with values obtained by adding unit numbers based on rounding conventions.
2. NA = Not applicable.
3. Pipelines not associated with roads
4. Two proposed stations are located on existing stations and are therefore not included in this disturbance.

Sources: Bell 2001, FS and BLM 2003.

The federal action that is the subject of federal decision-making under Alternative 2 would be to allow environmentally sound drilling of and subsequent production from 317 wells on 294 well pads on federal oil and gas leases in the Project Area.

Comprehensively, Alternative 2 includes the companies drilling 522 CBM wells on 499 well pads, and constructing about 203 miles of collocated access roads and pipelines on all jurisdictions in the Project Area. In addition, the companies would construct up to seven additional disposal wells and would install 15 new compressor sites. Table 2–5 summarizes the facilities that make up Alternative 2.

Alternative 2 requires the compression proposed for Alternative 1 (Table 2–2), plus three additional compressor stations at locations identified in Table 2–6. These stations would provide an additional 5,000 horsepower, resulting in a total 47,500 horsepower for the alternative.

**Table 2–6 Additional Compression Required for Alternative 2**

| Legal Description | Jurisdiction | Surface Disturbance (Acres) | Horsepower |
|---|---|---|---|
| Section 28U T34N R6 | NFS | 3.0 | 1,000 |
| Section 8U T34N R6W | NFS | 3.0 | 2,000 |
| Section 20U T34N R6W | NFS | 3.0 | 2,000 |
| Compression in proposed action | | 30.0 | 42,500 |
| Total | | 39.0 | 47,500 |

Note:
Source: Brown 2001, 2002

## 2.2.6 Alternative 3

Alternative 3 modifies the Proposed Action (Alternative 1) by reducing the number of wells in the HD Mountains Inventoried Roadless Area. Alternative 3 is considered in detail to address concerns about the impacts of CBM development within the HD Mountains Inventoried Roadless Area.

The federal action that is the subject of federal decision-making under Alternative 3 would be to allow environmentally sound drilling of and subsequent production from 113 wells on federal oil and gas leases in the Project Area.

Comprehensively, Alternative 3 includes the drilling of 212 CBM wells on 212 well pads, and constructing 78 miles of collocated access roads and pipelines and 10 miles of trunk line on all jurisdictions in the Project Area. The Alternative would also permit up to four disposal wells and 10 new compressor stations in the Project Area

The compression facilities would provide 34,640 additional horsepower, or 86 percent of the amount required in Alternative 1. Figure 2–6 shows the distribution of the facilities within the Project Area, and Table 2–7 summarizes the facilities that constitute Alternative 3.

## Table 2–5 Summary of Wells and Ancillary Facilities Required for Alternative 2

| | | Direct Ground Disturbance[1] | |
|---|---|---|---|
| Facility | Number | Short term (acres) | Long term (acres) |
| CBM Wells | | | |
| **BLM Lands** | **22** | **NA[2]** | **NA** |
| **National Forest System Lands** | **295** | **NA** | **NA** |
| State Lands | 15 | NA | NA |
| Private Lands | 190 | NA | NA |
| Total | 522 | NA | NA |
| CBM Well Pads | | | |
| **BLM Lands** | **22** | **31** | **22** |
| **National Forest System Lands** | **272** | **389** | **280** |
| State Lands | 15 | 21 | 15 |
| Private Lands | 190 | 266 | 190 |
| Total | 499 | 707 | 507 |
| Roads/Pipelines (total length in miles) | | | |
| **BLM Lands** | **6** | **30** | **19** |
| **National Forest System Lands** | **147** | **711** | **445** |
| State Lands | 3 | 15 | 10 |
| Private Lands | 47 | 227 | 143 |
| Total | 203 | 984 | 617 |
| Pipelines (total length in miles)[3] | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **4** | **19** | **0** |
| State Lands | 0 | 0 | 0 |
| Private Lands | < 1 | 1 | 0 |
| Total | 4 | 20 | 0 |
| Produced Water Disposal Wells | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **1** | **2** | **2** |
| State Lands | 0 | 0 | 0 |
| Private Lands | 0 | 0 | 0 |
| Outside the Project Area | 2 | 4 | 3 |
| Undetermined Location | 4 | 8 | 6 |
| Total | 7 | 14 | 11 |
| Trunk Pipelines | | | |
| Undetermined Location | 17 | 82 | 0 |
| Total (total length in miles) | 17 | 82 | 0 |
| Compressors | | | |
| Stations | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **10** | **24** | **24** |
| State Lands | 2 | 6 | 6 |
| Private Lands[4] | 2 | 3 | 3 |
| Outside the Project Area | 1 | 3 | 3 |
| Undetermined Locations | 0 | 0 | 0 |
| Total | 15 | 36 | 36 |
| Total Horsepower | 47,500 | NA | NA |
| Total Disturbance | NA | 1,843 | 1,171 |

Notes:

1. Totals may not match precisely with values obtained by adding unit numbers based on rounding conventions.
2. NA = Not applicable.
3. Pipelines not associated with roads
4. Two proposed stations are located on existing stations and are therefore not included in this disturbance

Sources: Bell 2001, FS and BLM 2003.

## Table 2–7 Summary of Wells and Ancillary Facilities required for Alternative 3

| | | Direct Ground Disturbance[1] | |
|---|---|---|---|
| Facility | Number | Short term (acres) | Long term (acres) |
| CBM Wells | | | |
| **BLM Lands** | **12** | **NA[2]** | **NA** |
| **National Forest System Lands** | **101** | **NA** | **NA** |
| State Lands | 7 | NA | NA |
| Private Lands | 92 | NA | NA |
| Total | 212 | NA | NA |
| CBM Well Pads | | | |
| **BLM Lands** | **12** | **17** | **12** |
| **National Forest System Lands** | **101** | **141** | **101** |
| State Lands | 7 | 10 | 7 |
| Private Lands | 92 | 129 | 92 |
| Total | 212 | 297 | 212 |
| Roads/Pipelines (total length in miles) | | | |
| **BLM Lands** | **3** | **14** | **9** |
| **National Forest System Lands** | **51** | **246** | **154** |
| State Lands | 2 | 8 | 5 |
| Private Lands | 22 | 107 | 67 |
| Total | 78 | 376 | 235 |
| Pipelines (total length in miles)[3] | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **1** | **5** | **0** |
| State Lands | 0 | 0 | 0 |
| Private Lands | 0 | 0 | 0 |
| Total | 1 | 5 | 0 |
| Produced Water Disposal Wells | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **0** | **0** | **0** |
| State Lands | 0 | 0 | 0 |
| Private Lands | 0 | 0 | 0 |
| Outside the Project Area | 2 | 4 | 3 |
| Undetermined Location | 2 | 4 | 3 |
| Total | 4 | 8 | 6 |
| Trunk Pipelines | | | |
| Undetermined Location | 10 | 49 | 0 |
| Total (total length in miles) | 10 | 49 | 0 |
| Compressors | | | |
| Stations | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **5** | **9** | **9** |
| State Lands | 2 | 6 | 6 |
| Private Lands[4] | 2 | 3 | 3 |
| Outside the Project Area | 1 | 3 | 3 |
| Undetermined Locations | 0 | 0 | 0 |
| Total | 10 | 21 | 21 |
| Total Horsepower | 34,640 | NA | NA |
| Total Disturbance | NA | 756 | 474 |

Notes:

1. Totals may not match precisely with values obtained by adding unit numbers based on rounding conventions.
2. NA = Not applicable.
3. Pipelines not associated with roads.
4. One proposed station is located on an existing station and is therefore not included in this disturbance.

Sources: Bell 2001, FS and BLM 2003.

## 2.2.7 Alternative 4

Alternative 4 modifies the Proposed Action (Alternative 1) by allowing for development of federal leases in accordance with the plan developed for the HD Mountains in 1992 and other BLM and FS plans, policy documents, and orders that currently guide development of CBM gas in the Project Area. These instruments include (1) the 1992 USFS HD Mountains CBM Gas Field Development Project FEIS, (2) the 1991 BLM San Juan/San Miguel Resource Management Plan Amendment, (3) the Interim Criteria for Fruitland CBM Development set forth in NTL No. CO-SJFO-2001-01 (2000), and (4) the conditional no surface occupancy stipulations imposed on five oil and gas leases. The assumptions for development of federal oil and gas leases under this alternative are as follows:

- A total of 73 wells and associated roads would be developed on NFS land and at locations specified in the 1992 HD Mountains CBM Development EIS and Field Development Plan. There would be limited development of the HD's Roadless Area.

- The Interim Criteria for Fruitland CBM development (described in Chapter 1, Section 1.8) would restrict development of federal leases within 1½ miles of the Fruitland outcrop pending this EIS completion.

- There are five leases in the HD Mountains issued in 2001 that have no-surface-occupancy (NSO) stipulations that are to be acted on in the record of decision (ROD) for this EIS. These leases were issued with the condition that a full range of development options, including surface occupancy scenarios, would be examined in this EIS, and that the NSO stipulations may be continued, waived, or excepted. These leases were issued with NSO stipulations for the purposes of complying with the January 12, 2001 Roadless Area Conservation Rule, to allow for further evaluation of a potential Research Natural Area and within portions of the leases, to avoid slopes greater than 40 percent (See the Land Use Section of Chapter 3). This alternative would continue no surface occupancy on those leases without waiver or exception.

The federal action that is the subject of federal decision-making under Alternative 4 would be to allow environmentally sound drilling of and subsequent production from 84 wells on federal oil and gas leases encompassing BLM lands and the HD Mountains.

The number of wells on private and state lands in the western portion of the Project Area is assumed the same as the Proposed Action (Alternative 1).

Comprehensively, Alternative 4 includes a total of 185 CBM wells on 185 well pads on all jurisdictions within the Project Area. The companies would construct about 91 miles of collocated access roads and pipelines and 10 miles of trunk line within the Project Area. Up to two disposal wells and six compressor stations would also be constructed. Figure 2–7 shows the distribution of the proposed facilities within the Project Area and Table 2–8 summarizes the facilities that constitute Alternative 4.

**Table 2–8 Wells and Ancillary Facilities Required for Alternative 4**

| Facility | Number | Direct Ground Disturbance[1] Short term (acres) | Direct Ground Disturbance[1] Long term (acres) |
|---|---|---|---|
| CBM Wells | | | |
| **BLM Lands** | **12** | **NA[2]** | **NA** |
| **National Forest System Lands** | **73** | **NA** | **NA** |
| State Lands | 7 | NA | NA |
| Private Lands | 93 | NA | NA |
| Total | 185 | NA | NA |
| CBM Well Pads | | | |
| BLM Lands | 12 | 17 | 12 |
| National Forest System Lands | 73 | 102 | 73 |
| State Lands | 7 | 10 | 7 |
| Private Lands | 93 | 130 | 93 |
| Total | 185 | 259 | 185 |
| Roads/Pipelines (total length in miles) | | | |
| **BLM Lands** | **3** | **14** | **9** |
| **National Forest System Lands** | **64** | **311** | **194** |
| State Lands | 1 | 3 | 2 |
| Private Lands | 23 | 111 | 70 |
| Total | 91 | 439 | 274 |
| Produced Water Disposal Wells | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **0** | **0** | **0** |
| State Lands | 0 | 0 | 0 |
| Private Lands | 0 | 0 | 0 |
| Outside the Project Area | 2 | 4 | 4 |
| Undetermined Location | 0 | 0 | 0 |
| Total | 2 | 4 | 4 |
| Trunk Pipelines | | | |
| Undetermined Location | 10 | 49 | 0 |
| Total (total length in miles) | 10 | 49 | 0 |
| Compressors | | | |
| Stations | | | |
| **BLM Lands** | **0** | **0** | **0** |
| **National Forest System Lands** | **3** | **6** | **6** |
| State Lands | 1 | 3 | 3 |
| Private Lands[3] | 1 | 3 | 3 |
| Outside the Project Area | 1 | 3 | 3 |
| Undetermined Locations | 0 | 0 | 0 |
| Total | 6 | 15 | 15 |
| Total Horsepower | 31,240 | NA | NA |
| Total Disturbance | NA | 766 | 478 |

Notes:

1. Totals may not match precisely with values obtained by adding unit numbers based on rounding conventions.
2. NA = Not applicable.
3. One proposed station is located on an existing station and is therefore not included in this disturbance.

Sources: Bell 2001, FS and BLM 2003.

## 2.2.8 Alternative 5 — No Action

Under the "No Action" alternative, the BLM and FS would not approve the proposed CBM operations on the Federal leases in the Project Area as submitted at this time. However, drilling would continue on private and state leases, and BLM and FS would grant access across federal lands where other reasonable routes are not available to reach proposed well sites on state and fee lands.

Under this alternative, the companies would drill an additional 117 wells on non-federal leases, thus reaching a density of four wells per section throughout much of the western and central sections of the Project Area. State and fee leases are under the regulatory jurisdiction of COGCC and not the federal agencies. The companies would also construct 40 miles of collocated access roads and pipelines, five compressor stations, and 10 miles of trunk line within the Project Area. Figure 2–8 shows the distribution of the proposed facilities within the Project Area. Table 2–9 summarizes the facilities that constitute Alternative 5.

The No Action Alternative does not meet the purpose and need for the proposed action, nor does it support the minerals management policies of the BLM and FS (for example, drilling only fee lands could initiate unauthorized drainage of Federal minerals). However, NEPA procedural regulations require that federal agencies evaluate in detail a “No Action” alternative that provides a baseline for comparing and measuring the effects of a proposed action and other “action” alternatives. The following considerations apply to the No Action alternative:

- The FS and BLM land and resource management plans provide for energy mineral development on all federal lands in the Project Area. Prior mineral leasing decisions over the past 25-years reflect this emphasis, and the majority of federal lands in the Project Area are leased (see Lease Status Figure in Chapter 1).

- An oil and gas lease grants the lessee the right to explore for, drill for, mine, extract, remove, and dispose of all leased resources, subject to stipulations attached to the lease to protect the surface and subsurface of the leased lands and the environment, restrictions derived from specific nondiscretionary statutes, and other restrictions as necessary to protect other surface resources consistent with lease rights (43 CFR 3101.1-2).

- All APDs encompassed by the proposed action are proposed on leases that have already been issued and grant the lessee/operator the rights described above. APD approval may only be denied when the proposed activity would constitute a violation of law and regulation or would cause unacceptable impacts, (43 U.S.C. 1732(b); 30 U.S.C. 226(g); 43 CFR 3101.1–2.

## Table 2–9 Wells and Ancillary Facilities required for Alternative 5 — No Action

| | | Direct Ground Disturbance[1] | |
|---|---|---|---|
| Facility | Number | Short term (acres) | Long term (acres) |
| CBM Wells | | | |
| BLM Lands | 0 | NA[2] | NA |
| National Forest System Lands | 15[3] | NA | NA |
| State Lands | 7 | NA | NA |
| Private Lands | 95 | NA | NA |
| Total | 117 | NA | NA |
| CBM Well Pads | | | |
| BLM Lands | 0 | 0 | 0 |
| National Forest System Lands | 15[3] | 21 | 15 |
| State Lands | 7 | 10 | 7 |
| Private Lands | 95 | 133 | 95 |
| Total | 117 | 164 | 117 |
| Roads/Pipelines (total length in miles) | | | |
| BLM Lands | 0 | 0 | 0 |
| National Forest System Lands | 15 | 70 | 44 |
| State Lands | 1 | 4 | 2 |
| Private Lands | 24 | 115 | 72 |
| Total | 39 | 189 | 118 |
| Produced Water Disposal Wells | | | |
| BLM Lands | 0 | 0 | 0 |
| National Forest System Lands | 0 | 0 | 0 |
| State Lands | 0 | 0 | 0 |
| Private Lands | 0 | 0 | 0 |
| Outside the Project Area | 0 | 0 | 0 |
| Undetermined Location | 0 | 0 | 0 |
| Total | 0 | 0 | 0 |
| Trunk Pipelines | | | |
| Undetermined Location | 10 | 49 | 0 |
| Total (total length in miles) | 10 | 49 | 0 |
| Compressors | | | |
| Stations | | | |
| BLM Lands | 0 | 0 | 0 |
| National Forest System Lands | 0 | 0 | 0 |
| State Lands | 2 | 6 | 6 |
| Private Lands[4] | 2 | 3 | 3 |
| Outside the Project Area | 1 | 3 | 3 |
| Undetermined Locations | 0 | 12 | 12 |
| Total | 5 | 12 | 12 |
| Total Horsepower | 13,740 | NA | NA |
| Total Disturbance | NA | 422 | 253 |

Notes:

1. Totals may not match precisely with values obtained by adding unit numbers due to rounding conventions.
2. NA = Not applicable.
3. These locations are on NFS surface overlying private minerals.
4. Two proposed stations are located on existing stations and are therefore not included in this disturbance.

Sources: Bell 2001, FS and BLM 2003.

## 2.3 Alternatives Considered but Eliminated from Detailed Study

Several alternatives were considered but eliminated from detailed study. These alternatives are described below, and the reasons they were excluded from detailed analysis are described.

| | |
|---|---|
| **Alternative Considered:** | **Staged rate of development.** |
| **Reasons Considered:** | This alternative was developed in response to issues raised during the scoping process. A slower rate of development would tend to spread any benefits or impacts over a longer period. This alternative would require the companies to limit drilling and develop the leases in stages over an extended 10- to 15-year schedule. |
| **Reasons eliminated:** | Under Section 4 of the lease terms (diligence, rate of development, unitization, drainage) the lessor (BLM) reserves the right to specify rates of development and production in the public interest, if deemed necessary for proper development and operation of area, field or pool. The provision is applicable from a reservoir management standpoint. BLM has used this provision to require the drilling of protective wells for drainage and, if necessary, to stop the drilling of wells that would result in waste, i.e. excessive reservoir depletion without adequate recovery. This lease provision would not support the concept of staged development from a surface standpoint unless from a reservoir management standpoint it could be demonstrated that allowing companies to drill their leases would result in waste. |
| **Alternative Considered:** | **Moratorium on development on all lands.** |
| **Reasons Considered:** | This alternative was considered in response to scoping comments. No further drilling or development of oil or gas wells would occur anywhere within the Project Area. |
| **Reasons Dropped:** | This alternative was eliminated from detailed consideration because a moratorium would be inconsistent with the Federal lease rights granted and contrary to 43 CFR 3101.1–2. Development of fee and state leases would continue regardless of BLM and FS decisions. |

| | |
|---|---|
| **Alternative Considered:** | **Analyze 80-acre CBM well density.** |
| **Reasons Considered:** | The well density of one well per 80 acres may allow optimum drainage and recovery of CBM gas. |
| **Reasons Dropped:** | The BLM spacing order dated May 3, 2000, and COGCC Order 112–156, effective July 11, 2000, limit the spacing of CBM wells in the Fruitland Formation to two per 320 acres in La Plata County and to one per 320 acres in Archuleta County. This alternative was eliminated from detailed consideration because it has not been proposed nor approved by either BLM or COGCC, nor is it deemed practical or technically warranted based on well performance and evidence presented to COGCC and BLM to date. |

## 2.4 Well Field Development Activities Common to All Alternatives

Appendix E describes well field development activities common to the alternatives. The Appendix describes the procedures and resources used to construct roads, well pads, and ancillary production facilities, and to operate wells and eventually plug, abandon, and reclaim the gas field. This detailed description of procedures and techniques is key to understanding the environmental protection measures used by the companies and required by the regulatory agencies. These requirements have evolved over time through extensive field monitoring and refinement and provide standards and safeguards for CBM gas development.

### 2.4.1 Environmental Protection Measures

General environmental protection measures for well development and production include the procedures described in the development, production, decommissioning, and reclamation sections of Appendix E. These procedures are subject to the applicable onshore orders, notices, and environmental protection measures listed below. Second, overarching mitigation measures that apply to federal jurisdiction within the Project Area are presented in this EIS. Additional mitigation measures are then developed on a site-specific basis as part of the environmental analysis conducted for individual APD submittals. These site-specific measures consist of surface mitigation requirements developed during the NEPA analysis and BLM stipulations that modify the drilling plan (if needed) as conditions of approval for the APD. The APDs on federal jurisdiction would be consistent with the management requirements presented in the record of decision for this EIS.

A complete APD consists of a surface use plan, a drilling plan, evidence of bond coverage, a description of applicable regulations, and BLM orders or notices. The surface use plan describes the access route, water supply, layout of the well site, production facilities, and waste disposal. The surface use plan also describes restoration and revegetation measures associated with the site-specific proposal for well development. The drilling plan includes information that describes the technical aspects of the specific proposal, including measures to protect subsurface resources and accountability for royalties. In addition, BLM Onshore Oil and Gas Orders and Notices to Lessees described below would be applied as standard operating procedures to individual projects and operators.

#### 2.4.1.1 BLM Applicable Onshore Orders and Notices

The following BLM regulations, orders, and notices apply to oil and gas operations in the Project Area:

- 43 CFR Part 3160 – Onshore Oil and Gas Operations
- Onshore Oil and Gas Operating Order No. 1 – Approval of Operations
- Onshore Oil and Gas Operating Order No. 2 – Drilling Operations
- Onshore Oil and Gas Operating Order No. 3 – Site Security
- Onshore Oil and Gas Operating Order No. 4 – Measurement of Oil
- Onshore Oil and Gas Operating Order No. 5 – Measurement of Gas
- Onshore Oil and Gas Operating Order No. 6 – Hydrogen Sulfide Operations
- Onshore Oil and Gas Operating Order No. 7 – Disposal of Produced Water
- Notice to Lessee 3A – Reporting of Undesirable Events
- Notice to Lessee 4A – Royalty or Compensation for Oil and Gas Lost

### 2.4.2 Hazardous Materials

#### 2.4.2.1 Chemical Use

The companies would use a variety of chemicals, including solvents, lubricants, paints, and additives during gas field development. The chemicals the companies may produce, use, store, transport, or dispose of during the project are identified on Table 2–10.

Potentially hazardous substances used to develop or operate wells are stored in limited quantities on well sites. The companies are required to follow the Material Safety Data Sheets when using such substances. Wastes generated by these processes typically include produced water, oilfield production fluids (including drilling muds and used fracturing fluids), crude oil and condensate, and contaminated soils. EPA and the Occupational Safety and Health Administration (OSHA) regulate these materials.

Disposal of some quantities of crude oil and condensate typically involves sale of these wastes to a waste oil recycler. Soils contaminated with relatively low concentrations of hydrocarbons (petroleum products) are generally disposed of in an approved landfill that accepts nonhazardous wastes. They may also be treated on site through land farming or aeration if permitted by the local regulatory agencies.

**Table 2–10 Hazardous Materials Used or Potentially Used by the Companies**

| | | Project Phase | | |
|---|---|---|---|---|
| Material | Primary Use | Construction | Production | Abandonment |
| Ammonia | Oil coolant/ compression | | X | |
| Gasoline | Vehicle fuel | X | X | X |
| Diesel fuel | Vehicle and equipment fuel | X | X | X |
| Motor oil | Vehicle lubricant | X | X | X |
| Greases/lubricants | Vehicle or equipment lubricant | X | X | X |
| Solvents | Equipment cleaning/degreasing | X | X | |
| Heat transfer fluids (glycols) | Removal of residual water | | X | |
| Flocculants | Filtration control | X | | |
| Lost circulation material | Controlling drilling circulation | X | | |
| Sodium hydroxide | PH control of drilling mud | X | X | |
| Buffers | PH control during completion | X | X | |
| Acids | Well stimulation | X | X | |
| Surfactants | Gas processing (CO2 removal) | | X | |
| Paint | Equipment painting | X | X | |
| Cement additives (accelerators and weight modification) | Cement casings and reworking within the well bore and abandonment | X | X | X |
| Sand | Fracture propant in hydro fracturing | X | X | |
| Inert gas | Well stimulation | X | X | |
| Welding and cutting material | Equipment welding and cutting | X | X | X |
| Fertilizers | Reclamation | X | X | X |
| Herbicides | Reclamation weed control | X | X | X |

Any operations that involve storage of large volumes of oil at CBM facilities are required by the provisions of 40 CFR 112 to prepare Spill Prevention Control and Countermeasures (SPCC) plans that specify containment requirements and drainage control measures to prevent any spills from reaching waters of the U.S.

### 2.4.2.2 Waste Sources and Controls

A variety of wastes are produced during the drilling and production phases. These wastes include drilling solids, steel drums, waste oils, spent oil filters, washer parts, cleaning solvents, spent water filters, water, triethylene glycol, and spent glycol filters. All wastes described in this section are recycled or disposed of in accordance with applicable laws and regulations.

Solids or cuttings are produced during the drilling stage. The cuttings are bits of rock produced as the drill bit bores though the target interval. The solids would be buried in the drilling pit after fluids have evaporated or have been pumped into trucks and transported to approved disposal facilities. These liquid wastes may include water, treatment fluids, and fracturing fluids.

Empty steel and plastic drums that contained materials such as caustic soda, citric acid, lubricating oil, methanol, and drilling additives require disposal or recycling. Empty metal or plastic drums are returned to the supplier.

Waste lubricating oil generated at the compressor stations and production sites are disposed of by the contractor. Some fluids are generated at compressor stations when pipelines are cleaned. These fluids are stored in a 50-gallon sump tank. The contents of the tank are removed by a contractor using a vacuum truck and are transported to a permitted disposal or recycling site.

Each compressor station creates an additional waste oil product through the bypass system. This waste is a combination of about 90 percent water and 10 percent hydrocarbons. The compressor bypass fluids also are piped to the sump tanks, as discussed above.

Solid wastes generated at the compressor stations include spent gas filters and cleaning rags that are handled as general trash and are sent to the regional landfill. Spent oil filters from the compressor lubrication systems are removed and disposed of at an approved facility.

Several waste streams are generated from the triethylene glycol dehydration line at the compressor stations. The dehydration units remove water from the gas stream by contacting the gas with triethylene glycol. Applying heat regenerates the glycol. The water is boiled off and released as steam.

Sanitary wastes are collected in portable toilets located on well pads during drilling and completion. The contractor pumps these toilets regularly and removes them when drilling and completion of the well are finished.

Construction materials and trash are transported to approved disposal areas. General trash would be collected in covered containers and periodically transported to approved disposal areas.

The existing federal statutes enacted to minimize risks to public health associated with hazardous materials and wastes include the Resource Conservation and Recovery Act 1976 (RCRA), the Superfund Amendments and Reauthorization Act of 1986 (SARA), which amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or "Superfund"), and the federal Clean Air, Clean Water, and Safe Drinking Water Acts (CAA, CWA, and SDWA). Federal and state regulations also apply.

Under CERCLA, listed hazardous substances are the elements, chemical compounds, and hazardous wastes that appear in Table 302.4, 40 CFR Part 302, Designation, Reportable Quantities, and Notification. The reportable quantity for each listed hazardous substance is also provided in Table 302.4. Spills or releases of reportable quantities that occur beyond the boundary of the facility must be reported to EPA and local agencies as required by Section 101(14) of CERCLA.

## 2.4.3 Safety and Emergency Response

This section describes the methods that the companies use to ensure safe operation of the natural gas wells during development and production. It also describes how the companies would respond to emergencies.

### 2.4.3.1 Geologic Hazards

Abnormally high pressure (blowouts) can occur during drilling operations. However, more than 1,000 CBM wells have been drilled in the Northern SJB with no recorded blowouts. All wells drilled are required to install Blowout Prevention Equipment (BOPE) to control any abnormal pressures that might be encountered. Blowouts are considered highly unlikely because of the BOPE, the shallow depths of the wells, the normal formation pressures, and experience in the Fruitland Formation.

### 2.4.3.2 Fires and Explosions

There is potential for leaks or ruptures from gas pipelines. Most ruptures are caused when heavy equipment accidentally strikes the pipeline when it is operating in close proximity. Ruptures can result in an explosion and fire if a spark or open flame were to ignite the escaping gas. Pipelines are designed and materials are selected in accordance with applicable standards to minimize the potential for a leak or rupture. Frequent signing is also installed along the pipelines to reduce the risk of accidental ruptures caused by excavating equipment. Additionally, the companies monitor flow in the pipeline either by remote sensors or by daily inspections of the flow meters. Monitoring therefore reduces the probability of ruptures by promoting prompt detection of leaks.

Well fires are rare, but may occur under certain conditions. The probability of a blowout is low for the reasons listed in the previous sections. However, as part of the emergency plan the companies would contract one of the several businesses that specialize in controlling well fires if a fire were to occur.

### 2.4.3.3 Public Safety

The Companies take measures to protect the public from hazards at well facilities. For example, all compressor stations would be fenced. According to OSHA regulations, a guardrail at pumping units would prevent people and large animals from injury by moving parts. In addition, warning signs would be posted around all facilities.

### 2.4.3.4 Employee Safety

The companies develop plans that cover potential emergencies including fires, employee injuries, and releases of chemicals and hydrogen sulfide ($H_2S$). The plans include telephone numbers for medical and emergency services and emergency contacts. The plans are posted at all local company offices and field facilities. All employees and subcontractors are knowledgeable of the emergency plan, and refresher courses are presented annually.

In addition, the companies generally do not allow on-duty employees and contractors to bring firearms into the area. They also orient employees and contractors to techniques that protect local wildlife.

## 2.5 Consistency with Law, Regulation

The Roadless Area Conservation Rule (RACR), promulgated January 12, 2001, would have established prohibitions on road construction and reconstruction in inventoried roadless areas on National Forest System lands with certain exceptions for roads associated with development of leasable minerals. However, on July 14, 2003, the United States District Court for the District of Wyoming issued an order that permanently enjoined RACR. Development activities on two leases in the HD Mountains Inventoried Roadless Area would have been subject to road construction/reconstruction prohibitions if RACR were in effect. The Forest Service provided consent to BLM to issue the leases at a time when the status of RACR was in question. Consequently, the leases were issued with no surface occupancy (NSO) stipulations subject to waiver, exception, or modification to be addressed in the environmental analysis and record of decision for this project.

The leaseholder has proposed to develop the one of the two leases in a manner that would require surface occupancy and a waiver of the NSO stipulation. This plan is embedded in Alternative 1 — The Proposed Action. Road construction and surface occupancy of the leases is also included in Alternatives 2 and 4. Alternatives 3 and 5 maintain the NSO requirements currently placed on the leases and would allow development of portions of the leases from outside the boundary of the inventoried roadless area.

The alternatives comply with all other applicable laws and regulations.

## 2.6 Summary of Alternatives and Environmental Consequences

Table 2–11 summarizes the alternatives in terms of their physical impact and facilities required for each alternative. Table 2–12 is a comparative summary of the environmental consequences that would be realized by implementing each of the alternatives.

### Table 2–11 Comparative Summary of Alternatives Considered in Detail

| | | Alternative | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Parameter | Existing | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| CBM Wells (number) | 276 | 296 | 283 | 231 | 522 | 212 | 185 | 118 |
| CBM Well Pads (number) | 276 | 273 | 211 | 158 | 499 | 212 | 185 | 118 |
| Short-Term Disturbance (acres) | NA | 1,113 | 965 | 690 | 1,843 | 756 | 766 | 422 |
| Long-term Disturbance (acres) | NA | 684 | 630 | 484 | 1,171 | 474 | 478 | 253 |
| Roads/Pipelines (total length in miles) | 191 | 118 | 94 | 62 | 203 | 78 | 91 | 40 |
| Gathering Pipelines (total length in miles) | 0 | 4 | 5 | 0 | 4 | 1 | 0 | 0 |
| Produced Water Disposal Wells (number) | 6 | 7 | 6 | 7 | 7 | 4 | 2 | 0 |
| Compressor Stations (number)[1] | 6 | 14 | 14 | 7 | 15 | 10 | 6 | 5 |
| Automated Central Gathering Station | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 |
| Total Compressor Horsepower | 24,400 | 42,500 | 42,500 | 42,500 | 47,500 | 34,640 | 31,240 | 13,740 |
| Compression Station Trunk Pipelines (total length in miles) | 5 | 17 | 17 | 17 | 17 | 10 | 10 | 10 |

Note:
1. Number of compressor stations resulting in new surface disturbance.

|  |  |  |  |
|---|---|---|---|
|  |  |  |  |
|  |  |  |  |
|  | 1 |  | 5 |
| **ISSUE** |  |  |  |
| **Methane Seeps** |  |  |  |
| Groundwater impacts. | Active methane seepage wou increase and affect a number domestic wells, seeps, and springs.<br>Any number of 20 water wel located on the Fruitland Formation may be affected w increased methane concentrations. | nilar to Alternative 3. | As with the other alternatives, up to 20 shallow domestic wells may see an increase in concentrations of methane, However, impacts may be later in the field development, and the smaller number CBM wells located near the outcrop may delay the impacts to some of the shallow water wells. |
| Surface water impacts. | Surface water affected by CE development is limited to sm springs emanating from the Fruitland Formation and the Pictured Cliffs Sandstone. La bodies of surface water (Tex Creek; the Animas, Pine, and Florida Rivers) are already subject to methane seepage fi naturally occurring methane and from the current CBM w field. These seeps are not predicted to increase in overa rate. Therefore, methane seep from additional CBM development would have no further impact these surface bodies. Squaw Creek, at Yellowjacket Pass, may experience increased methan seepage, and other unnamed springs along the eastern port of the outcrop may additional be affected by methane seepa as may the Piedra River. | nilar to Alternative 1. | Methane seeps would likely be lower in surface water bodies in the eastern portion of the Project Area. Squaw Creek, the Piedra River, and other small groundwater seeps and springs would likely see little or no impact because the intensity of development in the near-outcrop area would be reduced. Therefore, the seepage rates would be lower. Impacts to surface water bodies in the central and western Project Area would be similar to other alternatives because the existing wellfield would continue operating, and infill CBM development would continue on private leases. |
| Health and safety concerns. | Two homes along Fossett Gu Road may be affected by met seepage, thus exposing the residents to safety risks. | nilar to Alternative 1. | Two homes on the outcrop of the Fruitland Formation may be affected. However, the potential for this impact to occur is lessened with a lower intensity of development in this area when compared to the other alternatives. |
| Vegetation impacts. | Alternative 1 would likely ex the acreage of plant die-offs caused by methane seeps alo the Fruitland outcrop by 340 acres in addition to the 300 a affected by existing CBM development. | nilar to Alternative 1. | Some additional acreage may be affected in the eastern Project Area because of development on fee and private mineral estate. |
| Soil impacts. | About 340 acres of bare soils would be exposed on the outc of the Fruitland Formation | nilar to Alternative 1. | Fewer than 300 acres of bare soils would be exposed on the outcrop of the Fruitland Formation as a |

**Table 2–11 Comparative Summary of Alternatives Considered in Detail**

| | | Alternative | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | Existing | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| CBM Wells (number) | 276 | 296 | 283 | 231 | 522 | 212 | 185 | 118 |
| CBM Well Pads (number) | 276 | 273 | 211 | 158 | 499 | 212 | 185 | 118 |
| Short-Term Disturbance (acres) | NA | 1,113 | 965 | 690 | 1,843 | 756 | 766 | 422 |
| Long-term Disturbance (acres) | NA | 684 | 630 | 484 | 1,171 | 474 | 478 | 253 |
| Roads/Pipelines (total length in miles) | 191 | 118 | 94 | 62 | 203 | 78 | 91 | 40 |
| Gathering Pipelines (total length in miles) | 0 | 4 | 5 | 0 | 4 | 1 | 0 | 0 |
| Produced Water Disposal Wells (number) | 6 | 7 | 6 | 7 | 7 | 4 | 2 | 0 |
| Compressor Stations (number)[1] | 6 | 14 | 14 | 7 | 15 | 10 | 6 | 5 |
| Automated Central Gathering Station | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 |
| Total Compressor Horsepower | 24,400 | 42,500 | 42,500 | 42,500 | 47,500 | 34,640 | 31,240 | 13,740 |
| Compression Station Trunk Pipelines (total length in miles) | 5 | 17 | 17 | 17 | 17 | 10 | 10 | 10 |

Note:

1. Number of compressor stations resulting in new surface disturbance.

## Table 2-12 Summary of Effects, by Alternative

| | Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| **ISSUE** | | | | | | | |
| **Methane Seeps** | | | | | | | |
| Groundwater impacts. | Active methane seepage would increase and affect a number of domestic wells, seeps, and springs.<br>Any number of 20 water wells located on the Fruitland Formation may be affected with increased methane concentrations. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Similar impacts compared to Alternative 1. Although development would not occur in a large portion of the basin interior, wells nearer the outcrop would be drilled and operated, thus inducing methane seepage at levels similar to those predicted for Alternative 1. Approximately 20 domestic wells may be affected. | Impacts similar to Alternative 3. | As with the other alternatives, up to 20 shallow domestic wells may see an increase in concentrations of methane. However, impacts may be later in the field development, and the smaller number CBM wells located near the outcrop may delay the impacts to some of the shallow water wells. |
| Surface water impacts. | Surface water affected by CBM development is limited to small springs emanating from the Fruitland Formation and the Pictured Cliffs Sandstone. Larger bodies of surface water (Texas Creek; the Animas, Pine, and Florida Rivers) are already subject to methane seepage from naturally occurring methane seeps and from the current CBM well field. These seeps are not predicted to increase in overall rate. Therefore, methane seepage from additional CBM development would have no further impact these surface water bodies. Squaw Creek, at Yellowjacket Pass, may experience increased methane seepage, and other unnamed springs along the eastern portion of the outcrop may additionally be affected by methane seepage, as may the Piedra River. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Alternative 2 would be likely to accelerate the effects of methane seepage in surface water bodies along the outcrop of the Fruitland Formation. Increased methane seepage to surface water would negligibly affect surface water chemistry. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Methane seeps would likely be lower in surface water bodies in the eastern portion of the Project Area. Squaw Creek, the Piedra River, and other small groundwater seeps and springs would likely see little or no impact because the intensity of development in the near-outcrop area would be reduced. Therefore, the seepage rates would be lower. Impacts to surface water bodies in the central and western Project Area would be similar to other alternatives because the existing wellfield would continue operating, and infill CBM development would continue on private leases. |
| Health and safety concerns. | Two homes along Fossett Gulch Road may be affected by methane seepage, thus exposing the residents to safety risks. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Two homes on the outcrop of the Fruitland Formation may be affected. However, the potential for this impact to occur is lessened with a lower intensity of development in this area when compared to the other alternatives. |
| Vegetation impacts. | Alternative 1 would likely expand the acreage of plant die-offs caused by methane seeps along the Fruitland outcrop by 340 acres in addition to the 300 acres affected by existing CBM development. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Some additional acreage may be affected in the eastern Project Area because of development on fee and private mineral estate. |
| Soil impacts. | About 340 acres of bare soils would be exposed on the outcrop of the Fruitland Formation | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Fewer than 300 acres of bare soils would be exposed on the outcrop of the Fruitland Formation as a |

**Effects, by Alternative**

**tive**

|  | 3 | 4 | 5 |
|---|---|---|---|
|  |  |  |  |
|  |  |  | result of vegetation die-offs. These soils would be susceptible to accelerated erosion. |
|  |  |  |  |
| Vells and associated facilities vould result in long-term surface listurbance of about 1,096 acres, iighest among the alternatives. 'he impacts associated with andform disturbance are very ninor. | Wells and associated facilities would result in long-term surface disturbance of about 430 acres. The impacts associated with landform disturbance are very minor. | Wells and associated facilities would result in long-term surface disturbance of about 431 acres. The impacts associated with landform disturbance are very minor. | Wells and associated facilities would result in long-term surface disturbance of about 224 acres, lowest among the alternatives. The impacts associated with landform disturbance are very minor. |
| mpacts to paleontological esources would be potentially greater than the effects described under Alternative 1. Because nore than 200 additional well ads (nearly half on private and tate lands) would be developed under this alternative, it is likely hat more impacts could occur luring surface disturbing ctivities. | Impacts would be similar to Alternative 1 because private, state and BLM jurisdictions would be developed at the same level. As Alternative 1. Impacts on National Forest are potentially lower than Alternative 1 because 60 fewer well pads would be developed under this alternative than under Alternative 1. | Compared to Alternative 1,there would be 85 fewer well pads developed under Alternative 4 on NF land when compared Alternative. Therefore, the potential for paleontological impacts would be similar to but less than Alternative 1. | Alternative 5 would involve far fewer federal undertakings that would be subject to federal guidelines and regulations that protect paleontological resources than under Alternatives 1 through 4. Therefore, potential paleontological impacts would be the lowest among alternatives on NF land and the same as Alternative 1 on private, State and BLM jurisdiction. |
| mpacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. Drainage of federal CBM resources would increase because only non-federal CBM wells would be drilled. |

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|  | 1 |  | 5 |
| **ISSUE** |  |  |  |
|  | Mining likely could not occu near wellheads, injection wel pipelines, or utilities without damaging oil or gas producti facilities. |  |  |
| Impacts of produced water injection on subsurface geologic stability. | No excessive buildup of pres within rocks or fracturing of rocks is anticipated to result produced water injection. Therefore, no underground injection triggered earthquak would be expected. Undergr injection would be conducted accordance with federal and regulatory requirements. Inje wells would be authorized on where the injection zone is sufficiently porous and perm that fluids could enter the roc formation without causing an excessive buildup of pressure fracturing of rocks. | ilar to Alternative 1. | Effects similar to Alternative 1. |
| Impacts of Fruitland formation groundwater withdrawal on subsurface geologic stability. | Removal of water from the Fruitland coal seam would n cause noticeable ground subsidence or aquifer compression in the Project A under any of the alternatives. Water would be extracted fro the Fruitland formation, whic a consolidated rock unit and, therefore, would not be susceptible to noticeable subsidence. | ilar to Alternative 1. | Effects similar to Alternative 1. |
| Impacts of hydraulic fracturing or cavitation on subsurface geologic stability. | Hydraulic fracturing and cavitation would not compro the integrity of the coal and surrounding formations. Therefore, it is not expected t the stability of the subsurface geology would be affected. | ilar to Alternative 1. | Effects similar to Alternative 1. |
| Potential for increased CBM development to exacerbate existing coal fires or increase the likelihood of new coal fires. | Partial removal of water from coal seam near the coal outcr depressurizes the coal seam a could leave it in a condition where oxygen could replace in the coal seam and increase risk of spontaneous combusti Therefore, it is anticipated th the potential for coal fires my increase but should be mitiga by proper operation of the we | coal fires would ith fewer wells close to . | The risk of coal fires would decrease with fewer wells close to the outcrop. |

## Table 2-12 Summary of Effects, by Alternative

| | Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| **ISSUE** | | | | | | | |
| | outcrop as a result of vegetation die-offs. These soils would be susceptible to accelerated erosion. | | | | | | result of vegetation die-offs. These soils would be susceptible to accelerated erosion. |
| **Geology and Minerals** | | | | | | | |
| Effects of CBM development on landforms and physical landscapes. | CBM development would alter naturally occurring outcrops and deposits whenever surface exposures are excavated. The stratigraphy, structure, and contacts between geologic units would not be affected, however. | Wells and associated facilities would result in long-term surface disturbance of about 516 acres. The impacts associated with landform disturbance are very minor. | Wells and associated facilities would result in long-term surface disturbance of about 481acres. The impacts associated with landform disturbance are very minor. | Wells and associated facilities would result in long-term surface disturbance of about 1,096 acres, highest among the alternatives. The impacts associated with landform disturbance are very minor. | Wells and associated facilities would result in long-term surface disturbance of about 430 acres. The impacts associated with landform disturbance are very minor. | Wells and associated facilities would result in long-term surface disturbance of about 431 acres. The impacts associated with landform disturbance are very minor. | Wells and associated facilities would result in long-term surface disturbance of about 224 acres, lowest among the alternatives. The impacts associated with landform disturbance are very minor. |
| Paleontological effects. | Little of the Project Area has been inventoried for the presence of paleontological resources. Consequently, the number of paleontological sites that may be affected cannot be accurately estimated. Paleontological resources contained in near-surface horizons of soil and natural processes or human activity has likely already impacted surficial deposits. Surface use and shallow excavations likely would have little or no effect on paleontological resources that occur just below the surface. All facilities constructed on federal mineral ownership would be considered federal undertakings, and thus would be subject to federal guidelines and regulations that protect paleontological resources. | Reduced development under Alternative 1A, when compared with Alternative 1, would reduce the overall potential for surface disturbing activities to affect paleontological resources. | Reduced development under Alternative 1B would reduce the overall potential for surface disturbing activities to affect paleontological resources. | Impacts to paleontological resources would be potentially greater than the effects described under Alternative 1. Because more than 200 additional well pads (nearly half on private and state lands) would be developed under this alternative, it is likely that more impacts could occur during surface disturbing activities. | Impacts would be similar to Alternative 1 because private, state and BLM jurisdictions would be developed at the same level. As Alternative 1. Impacts on National Forest are potentially lower than Alternative 1 because 60 fewer well pads would be developed under this alternative than under Alternative 1. | Compared to Alternative 1.there would be 85 fewer well pads developed under Alternative 4 on NF land when compared Alternative. Therefore, the potential for paleontological impacts would be similar to but less than Alternative 1. | Alternative 5 would involve far fewer federal undertakings that would be subject to federal guidelines and regulations that protect paleontological resources than under Alternatives 1 through 4. Therefore, potential paleontological impacts would be the lowest among alternatives on NF land and the same as Alternative 1 on private, State and BLM jurisdiction. |
| Effect on coal or other mineral development opportunities. | CBM development is not expected to impact coal mining operations because no active coalmines occur in the Project Area or are planned in the future. Nor would future opportunities to mine coal be impacted after CBM extraction is completed or terminated.<br>CBM development could interfere with the potential recovery of sand, gravel, and aggregate. CBM development could remove an estimated 1 to 3 acres of land from mineable mineral reserves for each well that would be located in an area that could be surface mined. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. Drainage of federal CBM resources would increase because only non-federal CBM wells would be drilled. |

## Table 2-12 Summary of Effects, by Alternative

| | Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| **ISSUE** | | | | | | | |
| | Mining likely could not occur near wellheads, injection wells, pipelines, or utilities without damaging oil or gas production facilities. | | | | | | |
| Impacts of produced water injection on subsurface geologic stability. | No excessive buildup of pressure within rocks or fracturing of rocks is anticipated to result from produced water injection. Therefore, no underground injection triggered earthquakes would be expected. Underground injection would be conducted in accordance with federal and state regulatory requirements. Injection wells would be authorized only where the injection zone is sufficiently porous and permeable that fluids could enter the rock formation without causing an excessive buildup of pressure or fracturing of rocks. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. |
| Impacts of Fruitland formation groundwater withdrawal on subsurface geologic stability. | Removal of water from the Fruitland coal seam would not cause noticeable ground subsidence or aquifer compression in the Project Area under any of the alternatives. Water would be extracted from the Fruitland formation, which is a consolidated rock unit and, therefore, would not be susceptible to noticeable subsidence. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. |
| Impacts of hydraulic fracturing or cavitation on subsurface geologic stability. | Hydraulic fracturing and cavitation would not compromise the integrity of the coal and surrounding formations. Therefore, it is not expected that the stability of the subsurface geology would be affected. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. |
| Potential for increased CBM development to exacerbate existing coal fires or increase the likelihood of new coal fires. | Partial removal of water from the coal seam near the coal outcrop depressurizes the coal seam and could leave it in a condition where oxygen could replace water in the coal seam and increase the risk of spontaneous combustion. Therefore, it is anticipated that the potential for coal fires my increase but should be mitigated by proper operation of the wells. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | The risk of coal fires would increase with more wells close to the outcrop. | The risk of coal fires would decrease with fewer wells close to the outcrop. | The risk of coal fires would decrease with fewer wells close to the outcrop. | The risk of coal fires would decrease with fewer wells close to the outcrop. |

## Effects, by Alternative

### tive

| | 3 | 4 | 5 |
|---|---|---|---|
| | | | |
| | | | |
| roundwater resources would be ore affected at the outcrop areas f the Fruitland and Pictured liffs. Impacts in the western roject Area would increase nder Alternative 2 because of ncreased density of CBM wells ear the recharge areas.<br>mpacts in the eastern Project rea would include a more rapid rawdown of the water table long the outcrop compared to lternative 1. Effects on roundwater seeps and springs ould also be more rapid. The cceleration of impacts along the utcrop areas is a result of the ncreased CBM well density near he outcrop recharge areas. | Impacts similar to Alternative 1. | May result in slower, or smaller, declines in the water table near the outcrop areas in the eastern portion of the Project Area. | Alternative 5 would result in much lower impacts to the water table on the outcrop of the Fruitland Formation in the eastern portion of the Project Area. |
| mpacts similar to Alternative 1. he primary difference is that ncreases in pressure in deeper ormations would extend over a roader area because of increased umber of injection wells. | Slightly lower rate of produced water injected into deeper formations when compared to Alternative 1. | Slightly lower rate of produced water injected into deeper formations when compared to Alternative 1. | Slightly lower rate of produced water injected into deeper formations when compared to Alternative 1. |
| mpacts would be similar to lternative 1, except that | Impacts similar to Alternative 1 | Impacts similar to Alternative 1 | Impacts similar to Alternative 1 |

|  | 1 |  | 5 |
|---|---|---|---|
| **ISSUE** |  |  |  |
|  | formations and alter groundw chemistry. However, these ef will not be evident because tl deep zones will not mix with shallow zones because injecti wells are constructed and operated according to current regulations and best engineer practices.<br>Mixing of ground water betw aquifers would not occur fror dewatering the Fruitland formation. |  |  |
| **Surface Water** |  |  |  |
| Potential for surface water degradation as a result of petroleum product and produced water spills. | Potential short-term surface w quality impacts could result f accidental spills of fuel, lubricants, and fluids during construction of well pads, associated facilities, roads, ar pipelines in water influence z (WIZ). Long-term impacts ov the life of the project could oc from leaks or breaks in the pipelines that run from the we to the disposal facilities. Relocating facilities outside o WIZ, where possible, would reduce the potential for impac as would Spill Prevention Co and Countermeasures (SPCC plans using Best Managemen Practices (BMPs). The probability of spills is low. | milar to Alternative 1. | Impacts similar to Alternative 1 on non-federal lands and very low on Federal lands due to absence of development. |
| Potential for access roads and pipelines to degrade water quality. | CBM development would im 94 acres in the water influenc zone (WIZ) in the short term 62 acres in the WIZ in the lor term. This disturbance would lead to potential annual soil lc (potential sedimentation) of 8 tons per year in the WIZ in th short term and 565 in the long term. Well pads and roads wo be relocated or realigned to av disturbance in the WIZ where possible. Roads would be loca to avoid unstable slopes. Fac construction would avoid stre wetlands, and riparian areas where possible. | lopment would impact the WIZ in the short 2 acres in the WIZ in m. Disturbance would ential annual soil loss edimentation) of 857 short term and 571 in m. Potential impacts ality would be similar ve 1. | CBM development would impact 50 acres in the WIZ in the short term and 34 acres in the WIZ in the long term. Disturbance would lead to potential annual soil loss (potential sedimentation) of 431 tons in the short term and 297 in the long term. Potential impacts to water quality would be less than under Alternative 1. |
| Storm water runoff control. | Road density would increase 0.60 miles per square mile (mi./mi$^2$) and 0.04 stream | ty would be 0.46 l 0.04 stream crossings road. Impacts would | Road density would be 0.20 mi./mi$^2$ and no steam crossings are involved. Impacts would be |

## Table 2-12 Summary of Effects, by Alternative

|  | Alternative |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
|  | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| **ISSUE** |  |  |  |  |  |  |  |
| **Groundwater** |  |  |  |  |  |  |  |
| Potential for CBM dewatering to deplete groundwater in shallow aquifers. | The Fruitland formation is a confined hydrostraigraphic unit throughout most of the project area. Dewatering the coal beds would not affect the shallow aquifers within the interior of the Basin that supply almost all the domestic wells, municipal wells, and livestock wells within the Project Area.<br>Increased CBM development would, however, continue to draw down the water levels in wells located along the outcrops of the Fruitland and Pictured Cliffs formations. As many as 20 well owners may be affected by lower water tables in the outcrop area. The two deeper wells known to draw water from the Pictured Cliffs Sandstone are not likely to be affected to any significant degree by increased CBM development. Rather lowering the water levels in these two wells would continue as a result of the existing level of CBM development.<br>Draw down of the water table along the outcrop may affect groundwater seeps and springs. Effects in the western Project Area are not expected to increase under Alternative 1. Effects in the eastern portion of the Project Area would include draw down of the water table along the outcrop, with possible effects on springs and seeps. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Groundwater resources would be more affected at the outcrop areas of the Fruitland and Pictured Cliffs. Impacts in the western Project Area would increase under Alternative 2 because of increased density of CBM wells near the recharge areas.<br>Impacts in the eastern Project Area would include a more rapid drawdown of the water table along the outcrop compared to Alternative 1. Effects on groundwater seeps and springs would also be more rapid. The acceleration of impacts along the outcrop areas is a result of the increased CBM well density near the outcrop recharge areas. | Impacts similar to Alternative 1. | May result in slower, or smaller, declines in the water table near the outcrop areas in the eastern portion of the Project Area. | Alternative 5 would result in much lower impacts to the water table on the outcrop of the Fruitland Formation in the eastern portion of the Project Area. |
| Effect of produced water injection on basin hydrology. | Although the deep hydrology of the Basin will be affected by injection of produced water, these effects are not expected to manifest themselves in shallow aquifers or usable groundwater supplies. Impacts would not be evident as long as injection wells are constructed and operated according to current regulations and best engineering practices. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. The primary difference is that increases in pressure in deeper formations would extend over a broader area because of increased number of injection wells. | Slightly lower rate of produced water injected into deeper formations when compared to Alternative 1. | Slightly lower rate of produced water injected into deeper formations when compared to Alternative 1. | Slightly lower rate of produced water injected into deeper formations when compared to Alternative 1. |
| Effect of dewatering and injection on groundwater. | Injected produced water would increase pressure in the deep | Impacts similar to Alternative 1. | Impacts similar to Alternative 1 | Impacts would be similar to Alternative 1, except that | Impacts similar to Alternative 1 | Impacts similar to Alternative 1 | Impacts similar to Alternative 1 |

## Table 2-12 Summary of Effects, by Alternative

| | Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| **ISSUE** | | | | | | | |
| | formations and alter groundwater chemistry. However, these effects will not be evident because the deep zones will not mix with the shallow zones because injection wells are constructed and operated according to current regulations and best engineering practices.<br>Mixing of ground water between aquifers would not occur from dewatering the Fruitland formation. | | | increases in pressure in the deeper formations would extend over a broader area because of an increase in the number of injection wells. | | | |
| **Surface Water** | | | | | | | |
| Potential for surface water degradation as a result of petroleum product and produced water spills. | Potential short-term surface water quality impacts could result from accidental spills of fuel, lubricants, and fluids during construction of well pads, associated facilities, roads, and pipelines in water influence zones (WIZ). Long-term impacts over the life of the project could occur from leaks or breaks in the pipelines that run from the wells to the disposal facilities. Relocating facilities outside of the WIZ, where possible, would reduce the potential for impacts, as would Spill Prevention Control and Countermeasures (SPCC) plans using Best Management Practices (BMPs). The probability of spills is low. | Impacts similar to Alternative 1. However, the probability of a spill occurring would be lower than Alternative 1 because fewer wells, flow lines and facilities would be constructed under this alternative. | Impacts similar to Alternative 1. However, the probability of a spill occurring would be lower than Alternative 1 because fewer wells, flow lines and facilities would be constructed under this alternative. | Impacts similar to Alternative 1, but somewhat greater because of the higher level of development resulting from this alternative. | Impacts similar to Alternative 1 except there would be no possibility of spills in the HD Roadless Area because no development would occur in the area. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1 on non-federal lands and very low on Federal lands due to absence of development. |
| Potential for access roads and pipelines to degrade water quality. | CBM development would impact 94 acres in the water influence zone (WIZ) in the short term and 62 acres in the WIZ in the long term. This disturbance would lead to potential annual soil loss (potential sedimentation) of 879 tons per year in the WIZ in the short term and 565 in the long term. Well pads and roads would be relocated or realigned to avoid disturbance in the WIZ where possible. Roads would be located to avoid unstable slopes. Facility construction would avoid streams, wetlands, and riparian areas where possible. | CBM development would impact 92 acres in the WIZ in the short term and 63 acres in the WIZ in the long term. Disturbance would lead to potential annual soil loss (potential sedimentation) of 842 tons in the short term and 590 in the long term. Potential impacts to water quality would be less than Alternative 1. | CBM development would impact 57 acres in the WIZ in the short term and 40 acres in the WIZ in the long term. Disturbance would lead to potential annual soil loss (potential sedimentation) of 508 tons in the short-term and 357 in the long-term. Potential impacts to water quality would be less than Alternative 1 and 1A. | CBM development would impact 166 acres in the WIZ in the short term and 110 acres in the WIZ in the long term. Disturbance would lead to potential annual soil loss (potential sedimentation) of 1,553 tons in the short term and 1,029 in the long term. Potential impacts to water quality would be greater than Alternative 1. | CBM development would impact 70 acres in the WIZ in the short term, and 46 acres in the WIZ in the long term. Disturbance would lead to potential annual soil loss (potential sedimentation) of 644 tons in the short term and 415 in the long term. Potential impacts to water quality would be less than Alternative 1 primarily because no development would occur in the HD Mountains Roadless Area. | CBM development would impact 93 acres in the WIZ in the short term and 62 acres in the WIZ in the long term. Disturbance would lead to potential annual soil loss (potential sedimentation) of 857 tons in the short term and 571 in the long term. Potential impacts to water quality would be similar to Alternative 1. | CBM development would impact 50 acres in the WIZ in the short term and 34 acres in the WIZ in the long term. Disturbance would lead to potential annual soil loss (potential sedimentation) of 431 tons in the short term and 297 in the long term. Potential impacts to water quality would be less than under Alternative 1. |
| Storm water runoff control. | Road density would increase by 0.60 miles per square mile (mi./mi$^2$) and 0.04 stream | More well pads and roads would be constructed in areas of severe slope and high landslide potential. | Road density would be 0.32 mi./mi$^2$ and 0.04 stream crossings per mile of road. Impacts would | Road density would be 1.04 mi./mi$^2$ and 0.02 stream crossings per mile of road. Impacts would | Road density would be 0.40 mi./mi$^2$ and 0.02 stream crossings per mile of road. Impacts would | Road density would be 0.46 mi./mi$^2$ and 0.04 stream crossings per mile of road. Impacts would | Road density would be 0.20 mi./mi$^2$ and no steam crossings are involved. Impacts would be |

| Effects, by Alternative | | | |
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| | 3 | 4 | 5 |
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| e less than Alternative 1. Fewer vell pads and roads would be onstructed in areas of severe lope and high landslide potential. mpacts would be less than lternative 1. | be less than Alternative 1. Fewer well pads and roads would be constructed in areas of severe slope and high landslide potential. Impacts would be less than Alternative 1. | be less than Alternative 1. Construction of well pads and roads would be similar to Alternative 1, so impacts would be similar to Alternative 1. | the least of all alternatives. |
| mpacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Depletion in the Piedra River would be less than other alternatives because CBM development will not intercept groundwater that normally discharges to the Piedra River. |
| mpacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |
| verall, 261 acre-feet would be eeded and would be purchased rom municipal sources or private ntities. Individual landowners vould negotiate terms for the urchase of water. Therefore, .03 percent of irrigation use vould shift to industrial use. | Overall, 107 acre-feet would be needed and would be purchased from municipal sources or private entities. Individual landowners would negotiate terms for the purchase of water. Therefore, 0.03 percent of irrigation use would shift to industrial use. | Overall, 99 acre-feet would be needed and would be purchased from municipal sources or private entities. Individual landowners would negotiate terms for the purchase of water. Therefore, 0.03 percent of irrigation use would shift to industrial use. | Overall, 55 acre-feet would be needed and would be purchased from municipal sources or private entities. Individual landowners would negotiate terms for the purchase of water. Therefore, 0.03 percent of irrigation use would shift to industrial use. |
| mpacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1 except for appropriations from the Piedra River because CBM development would not intercept groundwater that normally discharges to the Piedra. |
| mpacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |

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|  | surface discharge would depe on specific water quality. |  |  |
| **Soils** |  |  |  |
| Impact of CBM development on soil stability, structure, texture, and biotic components of soil. | CBM development would im 85 acres of soils on severe sl and on 90 acres of soils with high potential for compactio shrink-swell. Soil stability w be reduced increasing the probability of erosion or landslides. Implementing B and installing proper drainag structures would reduce impa | lopment would occur s of soils on severe on 118 acres of soils potential for or shrink-swell. rosion or landslides uld be slightly less ative 1. | CBM development would occur on 17 acres of soils on severe slopes and on 84 acres of soils with a high potential for compaction or shrink-swell. Potential erosion or landslides impacts would be much less than Alternative 1 because of the limited development on severe slopes. |
| Soil erosion. | During construction, Alterna 1 would impact 147 acres wi high potential for water erosi and 51 acres of soils with hig potential for wind erosion, w some overlap of soils exhibit both hazards. During operati and maintenance, Alternative would impact 97 acres with h water erosion potential and 3 acres of soils with high wind erosion potential. Project-rel erosion would total 9,763 ton/year during construction 6,437 tons/year during the operational phase. Erosion impacts would be reduced by measures that include slope breakers, silt fencing, drainag dips, stockpile seeding, and graveling roads. | lopment would 85 ils with a high potential nd wind erosion. are also concentrated ern part of the Project level of project-related uld be 6,722 ton/year struction and 4,454 uring the operational acts would be slightly n Alternative 1. | CBM development would impact 55 acres of soils with a high potential for water and wind erosion. These soils are also concentrated in the western part of the Project Area. The level of project-related erosion would be 3,108 ton/year during construction and 2,091 tons/year during the operational phase. Impacts would be the least of all alternatives. |
| Potential for contaminant spills to affect soils. | Probability of spills is low at CBM sites. Spills would be contained, disposed of, or tre on site. Therefore, the proba of permanent soil contamina is very low. | ilar to Alternative 1. | Potential for contaminant spills is lower than Alternative 1 due to lower level of development in Alternative 5. |
| Impact to areas with poor revegetation potential and prime farmlands. | CBM development would im 365 acres of soils with poor potential for revegetation an acres of prime farmland. | 4 would impact 267 ls with poor potential ation and 24 acres of land. Impacts would Alternative 1. | Alternative 5 would impact 151 acres on soils with poor potential for revegetation. Impacts would be the least of all alternatives. |
| **Vegetation** |  |  |  |
| Impact of CBM development on vegetation in the Project Area, including wetlands, riparian areas. | Total vegetation converted to pads, roads, pipelines and compressors would equal 1,1 acres; riparian disturbance w equal 3 acres. | ation disturbance – riparian disturbance – | Total vegetation disturbance – 422 acres. |
| Impact on habitat structural | Forested areas reclaimed afte | ilar to Alternative 1. | Impacts similar to Alternative 1. |

| Table 2-12 Summary of Effects, by Alternative | | | | | | | |
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| | Alternative | | | | | | |
| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
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| | crossings per mile of road. All activities would be larger than 1 acre and would require a stormwater management plan that includes BMPs to control erosion from facilities and sedimentation to nearby water bodies. | Impacts would be slightly higher than Alternative 1. | be less than Alternative 1. More well pads and roads would be constructed in areas of severe slope and high landslide potential. Impacts would be slightly higher than Alternative 1. | be less than Alternative 1. Fewer well pads and roads would be constructed in areas of severe slope and high landslide potential. Impacts would be less than Alternative 1. | be less than Alternative 1. Fewer well pads and roads would be constructed in areas of severe slope and high landslide potential. Impacts would be less than Alternative 1. | be less than Alternative 1. Construction of well pads and roads would be similar to Alternative 1, so impacts would be similar to Alternative 1. | the least of all alternatives. |
| Impact of change in surface water flow on riparian areas and wetlands. | Surface water depletions are predicted to be less than one percent of base flow in the Animas, Pine, and Florida Rivers. Localized impacts to wetland and riparian areas could occur along perennial and ephemeral drainages crossed by access roads. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Depletion in the Piedra River would be less than other alternatives because CBM development will not intercept groundwater that normally discharges to the Piedra River. |
| Interaction between the Fruitland Aquifer and surface water systems after gas production ceases. | Rate of recharge primarily depends on meteoric recharge at the outcrop and not on leakage from streams that are hydraulically connected with the Fruitland Aquifer. Depletions less than one percent would occur over the life of the Project and interactions between surface flows and the Fruitland Aquifer would return to pre-CBM levels once the aquifer is recharged. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |
| Consumption of domestic and irrigation water for well development. | Overall, over the life of the project, 156 acre-feet of water would be required for drilling. Water would be purchased from municipal sources or private entities. Individual landowners would negotiate terms for the purchase of water. Therefore, 0.03 percent of irrigation use would shift to industrial use. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Overall, 261 acre-feet would be needed and would be purchased from municipal sources or private entities. Individual landowners would negotiate terms for the purchase of water. Therefore, 0.03 percent of irrigation use would shift to industrial use. | Overall, 107 acre-feet would be needed and would be purchased from municipal sources or private entities. Individual landowners would negotiate terms for the purchase of water. Therefore, 0.03 percent of irrigation use would shift to industrial use. | Overall, 99 acre-feet would be needed and would be purchased from municipal sources or private entities. Individual landowners would negotiate terms for the purchase of water. Therefore, 0.03 percent of irrigation use would shift to industrial use. | Overall, 55 acre-feet would be needed and would be purchased from municipal sources or private entities. Individual landowners would negotiate terms for the purchase of water. Therefore, 0.03 percent of irrigation use would shift to industrial use. |
| Effect of water depletions on existing surface water rights. | Existing water users would be affected by annual 140 acre-feet depletions in the Florida, Pine, and Animas Rivers and 15 to 60 acre-feet in the Piedra River, particularly during irrigation season when many streams in the Project Area are over-apportioned, therefore water rights holders would be impacted. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1 except for appropriations from the Piedra River because CBM development would not intercept groundwater that normally discharges to the Piedra. |
| Beneficial use of produced water. | Produced water would be marginal to poor quality. Marginal quality water may require treatment (reverse osmosis or ion exchange) to meet required standards for livestock and wildlife. Suitability of | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |

## Table 2-12 Summary of Effects, by Alternative

| | Alternative | | | | | | |
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| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
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| | surface discharge would depend on specific water quality. | | | | | | |
| **Soils** | | | | | | | |
| Impact of CBM development on soil stability, structure, texture, and biotic components of soil. | CBM development would impact 85 acres of soils on severe slopes and on 90 acres of soils with a high potential for compaction or shrink-swell. Soil stability would be reduced increasing the probability of erosion or landslides. Implementing BMPs and installing proper drainage structures would reduce impacts. | CBM development would occur on 68 acres of soils on severe slopes, and on 90 acres of soils with a high potential for compaction or shrink-swell. Potential erosion or landslides impacts would be less than Alternative 1. | CBM development would occur on 30 acres of soils on severe slopes, and on 90 acres of soils with a high potential for compaction or shrink-swell. Potential erosion or landslides impacts would be similar to Alternative 1 on soils with a high potential for compaction, but less than Alternative 1 for erosion on severe slopes. | CBM development would occur on 178 of soils on severe slopes and on 130 acres of soils with a high potential for compaction or shrink-swell. Potential erosion or landslides impacts would be greater than Alternative 1. | CBM development would occur on 40 of soils on severe slopes and on 90 acres of soils with a high potential for compaction or shrink-swell. Potential erosion or landslides impacts would be less than Alternative 1, primarily because no development would occur in the HD Roadless Area where severe slopes occur. | CBM development would occur on 64 acres of soils on severe slopes and on 118 acres of soils with a high potential for compaction or shrink-swell. Potential erosion or landslides impacts would be slightly less than Alternative 1. | CBM development would occur on 17 acres of soils on severe slopes and on 84 acres of soils with a high potential for compaction or shrink-swell. Potential erosion or landslides impacts would be much less than Alternative 1 because of the limited development on severe slopes. |
| Soil erosion. | During construction, Alternative 1 would impact 147 acres with high potential for water erosion and 51 acres of soils with high potential for wind erosion, with some overlap of soils exhibiting both hazards. During operation and maintenance, Alternative 1 would impact 97 acres with high water erosion potential and 34 acres of soils with high wind erosion potential. Project-related erosion would total 9,763 ton/year during construction and 6,437 tons/year during the operational phase. Erosion impacts would be reduced by measures that include slope breakers, silt fencing, drainage dips, stockpile seeding, and graveling roads. | Alternative 1A would impact 68 acres of soils with high potential for water erosion and 90 acres of soils with high potential for wind erosion during construction. During operation and maintenance, 79 acres of soils with high potential for water and 31 acres of soils with high potential for wind erosion would remain impacted. Project-related erosion would total 8,275 ton/year during construction and 5,834 tons/year during the operational phase. Impacts would be slightly less than Alternative 1. | Alternative 1B would impact 43 acres (31 acres after construction) of soils with a high potential for water and wind erosion. These soils are also concentrated in the western part of the Project Area. Project-related erosion would total 5,846 ton/year during construction and 4,396 tons/year during the operational phase. Impacts would be slightly less than Alternative 1A. | Alternative 2 would impact 327 acres of soils with high potential for water erosion and 92 acres of soils with high potential for wind erosion in the short term (with some overlap on soils that exhibit both characteristics). Two hundred sixteen acres of soils with high potential for water erosion and 62 acres of soils with high potential for wind erosion (with some overlap) would remain impacted in the long term after partial reclamation. These soils are also concentrated in the western part of the Project Area. The level of project-related erosion would be 16,265 ton/year during construction and 10,787 tons/year during the operational phase. Impacts would be greater than all other alternatives. | CBM development would impact 62 acres of soils with a high potential for water and wind erosion. These soils are also concentrated in the western part of the Project Area. The level of project-related erosion would be 6,615 ton/year during construction and 4,412 tons/year during the operational phase. Impacts would be slightly less than Alternative 1. | CBM development would 85 acres of soils with a high potential for water and wind erosion. These soils are also concentrated in the western part of the Project Area. The level of project-related erosion would be 6,722 ton/year during construction and 4,454 tons/year during the operational phase. Impacts would be slightly greater than Alternative 1. | CBM development would impact 55 acres of soils with a high potential for water and wind erosion. These soils are also concentrated in the western part of the Project Area. The level of project-related erosion would be 3,108 ton/year during construction and 2,091 tons/year during the operational phase. Impacts would be the least of all alternatives. |
| Potential for contaminant spills to affect soils. | Probability of spills is low at CBM sites. Spills would be contained, disposed of, or treated on site. Therefore, the probability of permanent soil contamination is very low. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Potential for contaminant spills is higher than Alternative 1 due to the higher level of development in Alternative 2. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Potential for contaminant spills is lower than Alternative 1 due to lower level of development in Alternative 5. |
| Impact to areas with poor revegetation potential and prime farmlands. | CBM development would impact 365 acres of soils with poor potential for revegetation and 24 acres of prime farmland. | Alternative 1A would impact 303 acres of soils with poor potential for revegetation and 24 acres of prime farmland. Impacts would be less than Alternative 1. | Alternative 1B would impact 230 of soils with poor potential for revegetation and 24 acres of prime farmland. Impacts would be less than Alternative 1A. | Alternative 2 would impact 664 acres of soils with poor potential for revegetation and 39 acres of prime farmland. Impacts would be greater than Alternative 1. | Alternative 3 would impact 296 acres of soils with poor potential for revegetation and 24 acres of prime farmland. Impacts would be less than Alternative 1. | Alternative 4 would impact 267 acres of soils with poor potential for revegetation and 24 acres of prime farmland. Impacts would be less than Alternative 1. | Alternative 5 would impact 151 acres on soils with poor potential for revegetation. Impacts would be the least of all alternatives. |
| **Vegetation** | | | | | | | |
| Impact of CBM development on vegetation in the Project Area, including wetlands, riparian areas. | Total vegetation converted to well pads, roads, pipelines and compressors would equal 1,113 acres; riparian disturbance would equal 3 acres. | Total vegetation disturbance would equal 965 acres and riparian disturbance would equal 3 acres. | Total vegetation disturbance – 690 acres; riparian disturbance – 3 acres. | Total vegetation disturbance – 1,834 acres; riparian disturbance – 3 acres. | Total vegetation disturbance – 756 acres; riparian disturbance – 3 acres. | Total vegetation disturbance – 766 acres; riparian disturbance – 3 acres. | Total vegetation disturbance – 422 acres. |
| Impact on habitat structural | Forested areas reclaimed after | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |

| Effects, by Alternative | | | |
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| | but the extent of impact would be greater that Alternative 1. | | But the extent of impact would be less than Alternative 1. |
| mpacts greater than Alternative 1 ecause of more facilities and and disturbed. | Impacts less than Alternative 1 because of fewer facilities and lands disturbed. | Impacts less than Alternative 1 because of fewer facilities and lands disturbed. | Impacts least of all alternatives because of fewest facilities and lands disturbed. |
| BM development would affect 6 acres (6 percent of old-growth onderosa pine in Project Area). mpacts would be the highest of ll the alternatives. | CBM development would affect 14 acres (2 percent of old-growth ponderosa pine in Project Area). Impacts would be less than Alternative 1. | CBM development would affect 14 acres (3 percent of old-growth ponderosa pine in Project Area). Impacts would be less than Alternative 1. | CBM development would affect 1 acre (0.3 percent of old-growth ponderosa pine in Project Area). Impacts would be the least of all alternatives. |
| mpacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |
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| Impact of additional CBM development on federal and state listed threatened, endangered, proposed, candidate, and sensitive plant species and their habitats. | Areas of proposed facilities would be surveyed for T, E, c sensitive plant species, and avoidance would be utilized t mitigate impacts. Therefore, implementation of any of the alternatives may adversely im individuals, but is not likely t result in a loss of viability on planning area. This determina is based on the low likelihood this species occurs within the Project Area, the implementat of pre-construction surveys ir suitable habitats that would b disturbed by each of the alternatives, and implementat of avoidance measures if new occurrences are discovered. | nilar to Alternative 1. | Impacts similar to Alternative 1. |
| **Wildlife** |  |  |  |
| Potential for wildlife harassment, roadkill, hunting pressure, and wildlife displacement. | In response to increased huma activity, equipment operation, vehicular traffic, and noise associated with all phases of e alternative, wildlife may avoi CBM development and production activities and disp to other locations. This avoida would result in the under-utilization of otherwise suitab habitats. Therefore, the effectiveness of these habitats supporting wildlife would be diminished. Wildlife distribut patterns would be altered. The degree of habitat avoidance would vary between species a among individuals of any particular species.<br>CBM well access roads would provide increased access to pu land in the Project Area as a whole; potentially leading to b increased legal-hunting pressu and poaching. Private landow would continue to control hun on, split-estate and private lan<br>Most project roads would be designed for slower speeds an not likely to cause any substan increase in vehicle collisions. Most collisions occur on coun roads and highways, where | similar to Alternative | Overall, wildlife impacts would be similar to Alternative 1 in the west side of the project area where CBM development is primarily on private and state land. Displacement, hunting and risk of vehicle collisions would be lower than Alternative 1 because CBM development of federal mineral estate would not proceed at this time. |

## Table 2-12 Summary of Effects, by Alternative

| | Alternative | | | | | | |
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| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
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| stages. | CBM development would differ substantially from undisturbed areas in terms of habitat structural stages (HSS). Reclaimed areas may not serve functions now served by undisturbed vegetation communities, particularly in the first few years, when species composition, shrub and tree cover, and other environmental factors would likely be different. Reclaimed areas would initially be in early seral HSSs, but would eventually develop into late seral HSSs in the absence of other disturbances. | | | | but the extent of impact would be greater that Alternative 1. | | But the extent of impact would be less than Alternative I. |
| Noxious weed control. | Operators would submit a noxious weed control plan during the APD process. Measures to reduce noxious weed infestations include pressure-washing vehicles before entering public lands; treating all infestations using methods approved by the Authorizing Officer and treating all infestations for 5 years after detection. | Impacts less than Alternative I because of fewer facilities and disturbed lands. | Impacts less than Alternative I because of fewer facilities and disturbed lands. | Impacts greater than Alternative I because of more facilities and land disturbed. | Impacts less than Alternative I because of fewer facilities and lands disturbed. | Impacts less than Alternative I because of fewer facilities and lands disturbed. | Impacts least of all alternatives because of fewest facilities and lands disturbed. |
| Effect on old-growth ponderosa pine and other old growth forest types. | CBM development would impact 36 acres (5 percent of old-growth ponderosa pine in Project Area). Because the old growth occurs in fairly continuous stands, avoidance may be difficult. | CBM development would impact 31 acres (5 percent of old-growth ponderosa pine in Project Area). Impacts would be less than Alternative I. | CBM development would impact 15 acres (2 percent of old-growth ponderosa pine in Project Area). Impacts would be less than Alternative IA. | CBM development would affect 36 acres (6 percent of old-growth ponderosa pine in Project Area). Impacts would be the highest of all the alternatives. | CBM development would affect 14 acres (2 percent of old-growth ponderosa pine in Project Area). Impacts would be less than Alternative 1. | CBM development would affect 14 acres (3 percent of old-growth ponderosa pine in Project Area). Impacts would be less than Alternative I. | CBM development would affect 1 acre (0.3 percent of old-growth ponderosa pine in Project Area). Impacts would be the least of all alternatives. |
| Impact on ecological processes including fire and insects and disease. | Frequency of human-caused wildfires may increase because of CBM development and road access. At the same time, the road network would increase ability to suppress fires and reduce spread in previously limited access areas. Cut trees and limbs during construction may increase *Ips* beetle infestation. | Impacts similar to Alternative I. | Impacts similar to Alternative I. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |

## Table 2-12 Summary of Effects, by Alternative

| | Alternative | | | | | | |
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| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
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| Impact of additional CBM development on federal and state listed threatened, endangered, proposed, candidate, and sensitive plant species and their habitats. | Areas of proposed facilities would be surveyed for T, E, or sensitive plant species, and avoidance would be utilized to mitigate impacts. Therefore, implementation of any of the alternatives may adversely impact individuals, but is not likely to result in a loss of viability on the planning area. This determination is based on the low likelihood that this species occurs within the Project Area, the implementation of pre-construction surveys in suitable habitats that would be disturbed by each of the alternatives, and implementation of avoidance measures if new occurrences are discovered. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |
| **Wildlife** | | | | | | | |
| Potential for wildlife harassment, roadkill, hunting pressure, and wildlife displacement. | In response to increased human activity, equipment operation, vehicular traffic, and noise associated with all phases of each alternative, wildlife may avoid CBM development and production activities and displace to other locations. This avoidance would result in the under-utilization of otherwise suitable habitats. Therefore, the effectiveness of these habitats in supporting wildlife would be diminished. Wildlife distribution patterns would be altered. The degree of habitat avoidance would vary between species and among individuals of any particular species.<br>CBM well access roads would provide increased access to public land in the Project Area as a whole; potentially leading to both increased legal-hunting pressure and poaching. Private landowners would continue to control hunting on, split-estate and private lands.<br>Most project roads would be designed for slower speeds and not likely to cause any substantial increase in vehicle collisions. Most collisions occur on county roads and highways, where | Impacts are similar to Alternative 1. | Impacts are similar to Alternative 1. | Wildlife displacement would be greater than that anticipated for Alterative 1. Hunting pressure would be similar to Alternative 1 and the risk of vehicle collisions would be slightly higher that Alternative 1 due to higher CBM industry traffic volume. | Impacts are similar to Alternative 1. | Impacts are similar to Alternative 1. | Overall, wildlife impacts would be similar to Alternative 1 in the west side of the project area where CBM development is primarily on private and state land. Displacement, hunting and risk of vehicle collisions would be lower than Alternative 1 because CBM development of federal mineral estate would not proceed at this time. |

**Effects, by Alternative**

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| o more than 2-percent of habitat or each MIS would be impacted y Alternative 2. | No more than 1-percent of habitat for each MIS would be impacted by Alternative 3. | No more than 1-percent of habitat for each MIS would be impacted by Alternative 4. | No more than 1-percent of habitat for each MIS would be impacted by Alternative 5. |
| mpacts similar to Alternative 1 | Impacts similar to Alternative 1 | Impacts similar to Alternative 1 | There would be no incremental impact to fisheries in the east side of the Project Area because development would not occur on federal mineral estate at this time. Fisheries impacts within the west side of the Project Area would be as described in Alternative 1. |

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|  | development would be insignificant, by comparison However, stream flows and temperatures are primary biological limiting factors fo trout populations occupying Project Area streams. As suc any water depletion may contribute to the overall cumulative effects of basin water uses on aquatic resour and fish populations, in and downstream from the Projec Area. |  |  |
| Effect of additional CBM development on federal and state listed threatened, endangered, proposed, candidate, and sensitive animal species and their habitats. | The Project "may affect – bu not likely to adversely affect federal and state listed threat endangered, proposed, candi and sensitive animal species their habitats. The exception fish species where the effect determination is: may affect, is likely to adversely affect, Colorado pikeminnow and razorback sucker. | milar to Alternative 1 | There would be no terrestrial species impacts on federal mineral estate because additional development would not proceed at this time. Endangered fish impacts would be the same as Alternative 1. Alternative 5 may affect, and is likely to adversely affect, the Colorado pikeminnow and razorback sucker. |
| **Cultural Resources** |  |  |  |
| Cultural resource impacts. | The overall average cultural density in the Project Area is sites per square mile. Based this average, four historic properties may be affected. Measures would be impleme to avoid impacts for properti under federal jurisdiction. 37 percent of CBM developmen would be on non-federal lan that may not be subject to fe jurisdiction. | milar to Alternative 3. | Most sites would be on non-federal land not subject to federal jurisdiction. Surface owner would have final decision on treatment. |
| Effect on traditional cultural properties. | See Above. | . | See Above. |
| **Land Use** |  |  |  |
| Agricultural and residential land use impacts. | CBM development would in 138 acres of agricultural lan and 104 acres of residential l | lopment would impact agricultural lands and ential lands. ce would less than e 1. | CBM development would impact 67 acres of agricultural lands and 49 acres of residential lands. Disturbance would be similar to Alternatives 3 and 4, and less than Alternative 1 |
| Unroaded area impacts. | Seventy-nine well pads and miles of roads would be constructed in the unroaded portion of the HD Mountains Approximately 40-percent of unroaded area would be | 4 would impact unroaded area, second mong the alternatives. guous unroaded area split into two residual ing 11,776 and 3,383 | Alternative 5 would not affect the unroaded portion of the Project Area. |

**Table 2-12 Summary of Effects, by Alternative**

| | Alternative | | | | | | |
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| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
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| | speeds are greater and where the vast majority of traffic is not CBM-related. Nevertheless, an increase in CBM traffic would occur on these roads, as well, and a minimal increase in vehicle collisions may occur. | | | | | | |
| Impact of additional CBM development on wildlife habitat. | Direct loss of wildlife habitat would occur under each alternative during the construction phase of the project, as a result of road, well pad, and other facility construction. Habitat loss would reduce available forage and habitat components in the affected area. Habitats next to those directly disturbed may be degraded by changes in vegetation, including the invasion of noxious weeds. Alternative 1 would impact no more than 1-percent of habitat for each MIS. | Alternative 1A would impact no more than 1-percent of habitat for each MIS | Alternative 1B would impact no more than 1-percent of habitat for each MIS | No more than 2-percent of habitat for each MIS would be impacted by Alternative 2. | No more than 1-percent of habitat for each MIS would be impacted by Alternative 3. | No more than 1-percent of habitat for each MIS would be impacted by Alternative 4. | No more than 1-percent of habitat for each MIS would be impacted by Alternative 5. |
| Fisheries impacts. | The abundance and distribution of brown trout within the Project Area are determined by stream flow and related water temperature dynamics. For the perennial streams in the Project Area, water temperatures increase, and brown trout abundance decreases, in a downstream progression. Coal bed methane development would reduce flows in perennial streams in and downstream of the Project Area. The dewatering of coal seams would reduce surface water flows by reducing groundwater discharge to streams, and by increasing surface water interception and infiltration<br>When combined, the depletions of surface flows resulting from the pumping of groundwater, and from the use of surface flows for drilling, deplete about 216 acre-feet per year. A variety of historic and ongoing water uses have had, and will continue to have, significant impacts on the above streams. The predicted changes in flow resulting from CBM | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1 | Impacts similar to Alternative 1 | Impacts similar to Alternative 1 | There would be no incremental impact to fisheries in the east side of the Project Area because development would not occur on federal mineral estate at this time. Fisheries impacts within the west side of the Project Area would be as described in Alternative 1. |

**Table 2-12 Summary of Effects, by Alternative**

| | Alternative | | | | | | |
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| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
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| | development would be insignificant, by comparison. However, stream flows and water temperatures are primary biological limiting factors for trout populations occupying Project Area streams. As such, any water depletion may contribute to the overall cumulative effects of basin wide water uses on aquatic resources and fish populations, in and downstream from the Project Area. | | | | | | |
| Effect of additional CBM development on federal and state listed threatened, endangered, proposed, candidate, and sensitive animal species and their habitats. | The Project "may affect – but is not likely to adversely affect federal and state listed threatened, endangered, proposed, candidate, and sensitive animal species and their habitats. The exception is fish species where the effects determination is: may affect, and is likely to adversely affect, the Colorado pikeminnow and razorback sucker. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1 | Impacts similar to Alternative 1 | Impacts similar to Alternative 1 | There would be no terrestrial species impacts on federal mineral estate because additional development would not proceed at this time. Endangered fish impacts would be the same as Alternative 1. Alternative 5 may affect, and is likely to adversely affect, the Colorado pikeminnow and razorback sucker. |
| **Cultural Resources** | | | | | | | |
| Cultural resource impacts. | The overall average cultural site density in the Project Area is 10.8 sites per square mile. Based on this average, four historic properties may be affected. Measures would be implemented to avoid impacts for properties under federal jurisdiction. 37 percent of CBM development would be on non-federal lands that may not be subject to federal jurisdiction. | Total disturbance on federal lands would be 23 percent less than Alternative 1. Overall, three historic properties may be affected. | Total disturbance on federal lands would be 54 percent less than Alternative 1. Overall, two historic properties may be affected. | Six historic properties may be affected. Measures would be implemented to avoid impacts for properties under federal jurisdiction. 31 percent of CBM development would be on non-federal lands that may not be subject to federal jurisdiction. | Two historic properties may be affected. Measures would be implemented to avoid impacts for properties under federal jurisdiction. 40 percent of CBM development would be on non-federal lands that may not be subject to federal jurisdiction. | Impacts similar to Alternative 3. | Most sites would be on non-federal land not subject to federal jurisdiction. Surface owner would have final decision on treatment. |
| Effect on traditional cultural properties. | See Above. | See Above. | See Above. | See Above. | See Above. | See Above. | See Above. |
| **Land Use** | | | | | | | |
| Agricultural and residential land use impacts. | CBM development would impact 138 acres of agricultural lands and 104 acres of residential lands. | Impacts similar to Alternative 1. | CBM development would impact 128 of agricultural lands and 106 acres of residential lands. Impacts would be similar to Alternative 1. | CBM development would impact 121 acres of agricultural lands and 152 acres of residential lands. Disturbance to agricultural lands would be slightly less than Alternative 1, but disturbance to residential lands would be greater than Alternative 1. | CBM development would impact 67 acres of agricultural lands and 50 of residential lands. Disturbance would be less than Alternative 1. | CBM development would impact 63 acres of agricultural lands and 50 of residential lands. Disturbance would less than Alternative 1. | CBM development would impact 67 acres of agricultural lands and 49 acres of residential lands. Disturbance would be similar to Alternatives 3 and 4, and less than Alternative 1 |
| Unroaded area impacts. | Seventy-nine well pads and 36 miles of roads would be constructed in the unroaded portion of the HD Mountains. Approximately 40-percent of the unroaded area would be | Alternative 1A would result in similar impact to the unroaded portion of the Project Area to those described for Alternative 1. A total of 12,637 acres would be impacted and 15,159 acres would | Alternative 1B would impact 6,297 acres of unroaded area, fourth among the alternatives in terms of overall impact. Two areas totaling 21,499 respectively would remain unroaded following | Alternative 2 would result in construction of 103 well pads and 61 miles of road in the unroaded portion of the HD Mountains. Alternative 2 would impact 22,799 acres of unroaded area. | Alternative 3 would not impact the HD Mountain Inventoried Roadless Area. In total, there would be 1,774 acres of unroaded area impacted, leaving a residual unroaded area of 26,022 acres | Alternative 4 would impact 13,616 of unroaded area, second highest among the alternatives. The contiguous unroaded area would be split into two residual areas totaling 11,776 and 3,383 | Alternative 5 would not affect the unroaded portion of the Project Area. |

Effects, by Alternative

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| he largest impact among the lternatives. Three residual ockets of unroaded area would emain, totaling 4.997 acres. | | acres, respectively. | |
| mpacts are the same as described or Alternative 1 | No wells would be drilled on lease COC-64935 or directionally drilled into the NSO lease.<br>No wells would be developed within lease area COC-64936 in Alternative 2. | One well would be drilled in lease area COC-64935, requiring partial waiver of the Lease's NSO stipulation.<br>Two wells would be developed Lease COC_64936, requiring partial waver of the leases NSO stipulation. | There would be no development of COC-63935 and COC-64936 at this time. |
| mpact the same as Alternative 1. | Impact the same as Alternative 1 | Impact the same as Alternative 1. | There would be no development of COC-64932 at this time. |
| | | | |
| ifteen wells would be onstructed within proximity of ie Grandview Trail system and 2 would be within proximity of ie Sauls Creek Trail. Overall npacts to the trail systems would e the highest under Alternative | One well would be within proximity of the Grandview Trail, and five would be within proximity of the Sauls Creek Trail. Impacts would be lower than Alternative 1. | One well would be within proximity of the Grandview Trail, and five would be within proximity of the Sauls Creek Trail. Impacts would be lower than Alternative 1. | One well would be constructed within proximity of the Grandview Trail system, and five would be within proximity the Sauls Creek Trail. Impacts would be lower than Alternative 1 |
| ffects greater than Alternative 1. ignificantly more well would be eveloped with a corresponding ss of backcountry setting | Effects similar to Alternative 1. | Effects similar to Alternative 1. | No effect on National Forest lands. Same effect as Alternative 1 in west side of project area on private, state and BLM land. |

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|  | alteration. |  |  |
| Effect of new access roads on recreation. | New roads would be constru into previously inaccessible Many of these roads would l gated and therefore not avail for expanded motorized recreation. The backcountry ambiance of much of the Na Forest portion of the project would be diminished. | ilar to Alternative 1. | No additional roads would be constructed within the National Forest portion of the Project Area, retaining its backcountry setting. Lands within the west side of the project area would experience the same level of development as Alternative 1, and thus the same diminishment of recreational setting. Motorized access to BLM lands would remain the same as current management. |
| Effect on wildlife-related recreation including wildlife viewing wildlife, hunting and fishing. | The number of hunters woul probably not increase becaus motorized use of most new r would be prohibited. New ac roads could be traveled on fo horseback, increasing ease o access to some hunters. The change in recreation setting t more developed may displac some hunters attracted to backcountry settings. For si reasons, fishing and wildlife viewing would probably not increase. | ilar to Alternative 1. | No development would occur on National Forest lands in the eastern portion of the project Area. On NF lands, traditional patterns of recreation use would remain unchanged. |
| **Transportation** |  |  |  |
| Effect of additional CBM development on transportation and roads. | Overall, 100 miles of new ac road would be constructed. ( that total, 76 miles of these r on National Forest would be gated and locked to prevent public motorized access. Tra increases on county roads an U.S. Highway 160, especiall during the construction phas would be small compared to average daily traffic volumes | 75 miles of new access d be constructed. travel management ; would not be placed l Forest roads. motorized access to al Forest would gnificantly when o current access. reases on county roads lighway 160 especially construction phase ess than Alternative 1 eater that currently d. | Overall, 31 miles of new access roads would be constructed. Access to the National Forest portion of the project area would not change Traffic increases on county roads and U.S. Highway 160 especially during the construction phase would be less than Alternative 1 but still greater that currently experienced. |
| Potential for new roads to promote illegal activities such as poaching, illegal woodcutting, disturbance of cultural sites, and wildlife disturbance.. | The 76 miles of new roads constructed on National Fore lands would be gated to restr public access. Illegal activiti could increase despite closur Closures would be closely monitored. | vel management policy change in Alternative ls would be open to ATV use. The oad system would ess to areas that were inaccessible to vehicles. Illegal uch as poaching, illegal utting and others, ase with expansion of | A total of 7 miles of new roads would be constructed on National Forest lands. Therefore, illegal activities should not increase. |

**Table 2-12 Summary of Effects, by Alternative**

| | Alternative | | | | | | |
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| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
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| | impacted, leaving 15,159 acres unroaded. | remain unroaded after full implementation of Alternative 1A. | the alternative's implementation. By horizontal drilling to a number of down-hole locations, some proposed access roads would be eliminated. Thus, the residual unroaded area would be slightly larger than Alternative 1. | the largest impact among the alternatives. Three residual pockets of unroaded area would remain, totaling 4,997 acres. | | acres, respectively. | |
| NSO leases within HD Mountain Inventoried Roadless Area. | The leaseholder has proposed nine-wells within the lease area COC-64935, currently issued with a no-surface-occupancy stipulation. There are no well proposed within lease COC-94936 at this time. | Alternative 1A would develop two wells within lease COC-64935 and access the other down-hole locations within the lease by horizontally drilling from the lease perimeter. There would be no wells drilled within lease COC-64936 at this time. | Alternative 1B would develop one well within lease COC-64935 and access the other down-hole locations within the lease by horizontally drilling from the single well pad. There would be no wells drilled within lease COC-64936 at this time. | Impacts are the same as described for Alternative 1 | No wells would be drilled on lease COC-64935 or directionally drilled into the NSO lease.<br>No wells would be developed within lease area COC-64936 in Alternative 2. | One well would be drilled in lease area COC-64935, requiring partial waiver of the Lease's NSO stipulation.<br>Two wells would be developed Lease COC_64936, requiring partial waver of the leases NSO stipulation. | There would be no development of COC-63935 and COC-64936 at this time. |
| Development of Archuleta Mesa – Potential Research Natural Area. | There are eight wells and one compressor proposed within lease COC-64932 (Archultea Mesa lease). Decisions regarding NSO waiver would hinge on a Forest Plan decision regarding whether to recommend Deep Creek for inclusion in the system of research natural areas. The NSO would remain in effect at least until the record of decision for the forest plan revision. If not recommended for research natural area, exceptions of the Deep Creek NSO stipulation would be evaluated on a case-by case basis through APD submission and associated NEPA analyses. | Impact the same as Alternative 1. | Impact the same as Alternative 1. | Impact the same as Alternative 1. | Impact the same as Alternative 1 | Impact the same as Alternative 1. | There would be no development of COC-64932 at this time. |
| **Recreation** | | | | | | | |
| Impact of additional CBM development on trail system and users. | The opportunity for solitude for recreational users on the Grandview Ridge and Sauls Creek trails would be diminished by CBM development. One well would be developed within proximity of the Grandview trail system and 12 would be within proximity of the Sauls Creek Trail. Additionally, two compressor stations are proposed within the Sauls Creek area. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Fifteen wells would be constructed within proximity of the Grandview Trail system and 12 would be within proximity of the Sauls Creek Trail. Overall impacts to the trail systems would be the highest under Alternative 2. | One well would be within proximity of the Grandview Trail, and five would be within proximity of the Sauls Creek Trail. Impacts would be lower than Alternative 1. | One well would be within proximity of the Grandview Trail, and five would be within proximity of the Sauls Creek Trail. Impacts would be lower than Alternative 1. | One well would be constructed within proximity of the Grandview Trail system, and five would be within proximity the Sauls Creek Trail. Impacts would be lower than Alternative 1 |
| Effect on recreation opportunities. | The solitude and natural setting now provided would be impacted over much of the National Forest portion of the project area. Other portions of the Project Area have experienced some level of development and landscape | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects greater than Alternative 1. Significantly more well would be developed with a corresponding loss of backcountry setting | Effects similar to Alternative 1. | Effects similar to Alternative 1. | No effect on National Forest lands. Same effect as Alternative 1 in west side of project area on private, state and BLM land. |

**Table 2-12 Summary of Effects, by Alternative**

| | Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
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| | alteration. | | | | | | |
| Effect of new access roads on recreation. | New roads would be constructed into previously inaccessible areas. Many of these roads would be gated and therefore not available for expanded motorized recreation. The backcountry ambiance of much of the National Forest portion of the project area would be diminished. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects would be similar to Alternative 1. However, no roads would be constructed in the HD Mountains Roadless Area, thus retaining the backcountry setting of that area. | Effects similar to Alternative 1. | No additional roads would be constructed within the National Forest portion of the Project Area, retaining its backcountry setting. Lands within the west side of the project area would experience the same level of development as Alternative 1, and thus the same diminishment of recreational setting. Motorized access to BLM lands would remain the same as current management. |
| Effect on wildlife-related recreation including wildlife viewing wildlife, hunting and fishing. | The number of hunters would probably not increase because motorized use of most new roads would be prohibited. New access roads could be traveled on foot or horseback, increasing ease of access to some hunters. The change in recreation setting to more developed may displace some hunters attracted to backcountry settings. For similar reasons, fishing and wildlife viewing would probably not increase. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects would be similar except in the HD Mountains Roadless Area where no development would occur. In that area, traditional uses of the area for recreation would continue unaltered. | Effects similar to Alternative 1. | No development would occur on National Forest lands in the eastern portion of the project Area. On NF lands, traditional patterns of recreation use would remain unchanged. |
| **Transportation** | | | | | | | |
| Effect of additional CBM development on transportation and roads. | Overall, 100 miles of new access road would be constructed. Of that total, 76 miles of these roads on National Forest would be gated and locked to prevent public motorized access. Traffic increases on county roads and U.S. Highway 160, especially during the construction phase, would be small compared to the average daily traffic volumes. | Overall, 74 miles of new access road would be constructed. A total of 49 miles of road on National Forest would be gated and locked to prevent motorized access. Traffic increases on county roads and U.S. Highway 160 would be approximately the same as Alternative 1. | A total of 57 miles of new access road would be constructed. Of this total, 33 miles of roads would be gated on National Forest lands to prevent motorized access. Traffic increases on county roads and U.S. Highway 160 especially during the construction phase would be slightly less than Alternative 1. | Overall, 177 miles of new access roads would be constructed. Of this total, 131 miles of new roads on National Forest lands would be gated and locked to prevent motorized access. Traffic increases on county roads and U.S. Highway 160 especially during the construction phase would be greater than Alternative 1 because of the significantly higher level of development than Alternative 1. | Overall, 61 miles of new access roads would be constructed. The 36 miles of new road on National Forest lands would be gated to prevent motorized access. There would be no new road construction in the HD's Roadless Area. Therefore the patterns of access to the area would remain unchanged. Traffic increases on county roads and U.S. Highway 160 especially during the construction phase would be less than Alternative 1 because of the construction of 61 fewer well pads. | A total of 75 miles of new access roads would be constructed. Additional travel management restrictions would not be placed on National Forest roads. Therefore, motorized access to the National Forest would increase significantly when compared to current access. Traffic increases on county roads and U.S. Highway 160 especially during the construction phase would be less than Alternative 1 but still greater that currently experienced. | Overall, 31 miles of new access roads would be constructed. Access to the National Forest portion of the project area would not change Traffic increases on county roads and U.S. Highway 160 especially during the construction phase would be less than Alternative 1 but still greater that currently experienced. |
| Potential for new roads to promote illegal activities such as poaching, illegal woodcutting, disturbance of cultural sites, and wildlife disturbance.. | The 76 miles of new roads constructed on National Forest lands would be gated to restrict public access. Illegal activities could increase despite closures. Closures would be closely monitored. | The 49 miles of new roads would be gated and the majority closed to motorized use. Illegal activities, such as poaching could increase. | The 33 miles of new roads would be gated and the majority closed to motorized. Illegal activities, such as poaching could increase. | 131 miles of new roads would be constructed on National Forest lands. The vast majority would be gated and closed to the public. However, the expanded road system could contribute to an increase in illegal activities behind closed gates. | Impacts are the same as Alternative 1B. Roads would not be constructed in the HD's Roadless Area, so activities within that area should not change. | Current travel management policy would not change in Alternative 4. All roads would be open seasonally to ATV use. The expanded road system would provide access to areas that were previously inaccessible to motorized vehicles. Illegal activities such as poaching, illegal firewood cutting and others, could increase with expansion of | A total of 7 miles of new roads would be constructed on National Forest lands. Therefore, illegal activities should not increase. |

**Effects, by Alternative**

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| | | the road system. | |
| ffects similar to Alternative 1. | No roads would be constructed in the HD Mountains Roadless Area. Patterns of recreation use would remain unchanged. | A larger portion of the Roadless Area would be roaded when compared to Alternative 1. Overall roadless area recreation impacts would be similar to Alternative 1. | No roads would be constructed in the HD Mountains Roadless Area. Patterns of recreation use would not change. |
| ffects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. |
| ffects similar to Alternative 1. | Effects similar to Alternative 1. | Impacts to county roads would be slightly less than Alternative 1 within the east side of the project area, and the same as Alternative 1 throughout the rest of the project area. | There would be no change in CBM induced traffic on the east side of the project area, and thus no change in county road traffic patterns. The west side of the project area would experience increase in heavy truck traffic similar to Alternative 1. |
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| isual impacts would exceed the S visual objective of Retention n the foreground view (to ½ ile) for 17 acres from residential rea, 88 acres from roads, and 79 cres from recreational areas. | Visual impacts would exceed the FS visual objective of Retention in the foreground view (to ½ mile) for 60 acres from residential area, 54 acres from roads, and 39 acres from recreational areas. | Visual impacts would exceed the FS visual objective of Retention in the foreground view (to ½ mile) for 10 acres from residential area, 45 acres from roads, and 27 acres from recreational areas. | Visual impacts would exceed the FS visual objective of Retention in the foreground view (to ½ mile) for 10 acres from residential area, 42 acres from roads, and 18 acres from recreational areas. |
| isual impacts would be similar o Alternative 1 but significantly reater within the Fruitland utcrop zone and Spring Creek reas of the Project Area: | Visual impact would be similar to Alternative 1 but absent for the HD's Roadless Area where no further development would take place | Visual impacts would be lower than Alternative 1 in the National Forest portion of the Project Area and the same as Alternative 1 throughout the rest of the project area. Overall, impacts would be moderate to high in localized areas. | There would be no additional visual impact through out most of the HD Mountains, with the exception of Sauls Creek where CBM development on private land would incrementally increase visual impacts. Visual impacts would be the same as Alternative 1 throughout the rest of the Project Area, where impacts would be moderate to high in localized situations. |
| mpacts would be slightly greater the western portion of the | Impacts would be less than Alternative 1 because of fewer | Impacts similar to Alternative 3. | Impacts would be the least of all alternatives because of the least |

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| lines, fences, and roads. | more noticeable than short or curved facilities following te features. These facilities wo be most noticeable at short distances in the western porti of the Project Area because o population density. However linear features on elevated te in the eastern portion of the Project Area would also be e seen from all elevations exce where topography would scre these features. | | number of linear facilities. |
| Visual effects of flaring, | Typically, a CBM well woul flared for 3 to 5 days. Witho topographic or vegetative screening, the flare would be at distances to 3 miles and sometime more. A reflection low clouds would make the e more noticeable. It is assume that 1 to 3 wells would be fla at any time. Impacts would b temporary and low. | ould be slightly less ative 1 because it is at fewer than three d be flared at any time. | Impacts similar to Alternative 1 throughout the west side of the project area. No impact within the National Forest portion of the Project Area, with exception of Sauls Creek where limited additional development would occur on private land. |
| Visual consequences of nighttime lighting of compressor stations. | Fourteen new compressor sta would be lighted with downw directed light that would dimi the night shine from these facilities. However, the static would be visible at night especially for nearby resident Impacts would be localized a moderate. | mpressor stations ghted with downward- ht that would diminish ine from these npacts would be d moderate. | Five new compressor stations would be lighted with downward-directed light that would diminish the night shine from these facilities. Impacts would be localized and moderate. |
| **Noise** | | | |
| Impact of day and nighttime noise levels associated with construction, drilling, and operation of CBM facilities. | Construction noise levels wo be below Colorado Oil and G Conservation Commission (COGCC) standards 100 feet from the activities. Construct would occur only during dayt hours. Drilling noise would b below COGCC standards at 1 feet during the day and 3,000 during the night. Pump jack noise would be below COGC noise standards at 150 feet du the day and 375 feet during th night. Compressor station noi would be below COGCC standards at 350 feet during th day and 650 feet during the ni Five new compressor stations could be located within 650 fe of Noise Sensitive Areas (NS in the western portion of the | pump jacks could y operate near or proposed areas. Additional ay be required to meet ise standards. Four essor stations could be feet of NSAs in the tion of the Project itional setbacks from may be required. | In total, 52 pump jacks could permanently operate near established or proposed residential areas. Additional setbacks may be required to meet COGCC noise standards. Three new compressor stations could be within 650 feet of NSAs in the western portion of the Project Area. Additional setbacks from these NSAs may be required. |

## Table 2-12 Summary of Effects, by Alternative

| | Alternative | | | | | | |
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| **ISSUE** | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| | | | | | | the road system. | |
| Impacts on recreation in the HD Roadless Area. | Roads would be constructed in the HD Mountains Roadless Area making it easier for persons on foot or horseback to traverse portions of the area. All new roads would be gated to prohibit motorized access. Nevertheless, foot and horseback traffic could increase along with illegal use of the road system by ATV's. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | No roads would be constructed in the HD Mountains Roadless Area. Patterns of recreation use would remain unchanged. | A larger portion of the Roadless Area would be roaded when compared to Alternative 1. Overall roadless area recreation impacts would be similar to Alternative 1. | No roads would be constructed in the HD Mountains Roadless Area. Patterns of recreation use would not change. |
| Effect of gas industry traffic on public safety. | The probability of increased traffic accidents would be small because the expected CBM traffic volume would be less than 1 percent of the average daily traffic volume on county roads and U.S. Highway 160. However, there may be an increased potential for incidents at road intersections where traffic turns onto county roads. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. |
| Effect of industry vehicles on road surfaces and maintenance levels. | A 26-percent increase in heavy trucks on county roads would accelerate road deterioration. However, traffic of this vehicle size would be limited to the short-term construction phase of about 2 weeks for each well drilled. La Plata County requires the operators to maintain county roads to a level determined adequate by the county engineer. | Effects similar to Alternative 1. | There would be slightly less truck traffic within the east side of the project area when compared to Alternative 1, and thus less wear and tear on County access roads. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Impacts to county roads would be slightly less than Alternative 1 within the east side of the project area, and the same as Alternative 1 throughout the rest of the project area. | There would be no change in CBM induced traffic on the east side of the project area, and thus no change in county road traffic patterns. The west side of the project area would experience increase in heavy truck traffic similar to Alternative 1. |
| **Visual Resources** | | | | | | | |
| Visual effect of CBM development in relationship to FS' visual management guidelines. | Visual impacts would exceed the FS visual objective of Retention in the foreground view (to ½ mile) for 80 acres from residential areas, 53 acres from roads, and 57 acres from recreational areas. | Visual impacts would exceed the FS visual objective of Retention in the foreground view (to ½ mile) for 83 acres from residential area, 43 acres from roads, and 59 acres from recreational areas. | Visual impacts would exceed the FS visual objective of Retention in the foreground view (to ½ mile) for 81 acres from residential area, 22 acres from roads, and 37 acres from recreational areas. | Visual impacts would exceed the FS visual objective of Retention in the foreground view (to ½ mile) for 17 acres from residential area, 88 acres from roads, and 79 acres from recreational areas. | Visual impacts would exceed the FS visual objective of Retention in the foreground view (to ½ mile) for 60 acres from residential area, 54 acres from roads, and 39 acres from recreational areas. | Visual impacts would exceed the FS visual objective of Retention in the foreground view (to ½ mile) for 10 acres from residential area, 45 acres from roads, and 27 acres from recreational areas. | Visual impacts would exceed the FS visual objective of Retention in the foreground view (to ½ mile) for 10 acres from residential area, 42 acres from roads, and 18 acres from recreational areas. |
| Visual impacts of CBM development when viewed from sensitive viewpoints including highways, roads, and residential areas. | CBM facilities, especially compressor stations and pump jacks, would be noticeable in sensitive viewshed areas. Visual impacts would be greatest where development encroaches on residential areas, along roads, and in open areas not screened by topography or vegetation. Overall, visual intrusion would be moderate to high in localized areas | Effects are similar to Alternative 1 although there would be slightly lower visual impact in the Pargin Mountain portion of the Project Area. | Visual impacts would be the same as Alternative 1 within the west side of the project area, and visually much less intrusive on the National Forest portion of the Project Area. | Visual impacts would be similar to Alternative 1 but significantly greater within the Fruitland outcrop zone and Spring Creek areas of the Project Area: | Visual impact would be similar to Alternative 1 but absent for the HD's Roadless Area where no further development would take place | Visual impacts would be lower than Alternative 1 in the National Forest portion of the Project Area and the same as Alternative 1 throughout the rest of the project area. Overall, impacts would be moderate to high in localized areas. | There would be no additional visual impact through out most of the HD Mountains, with the exception of Sauls Creek where CBM development on private land would incrementally increase visual impacts. Visual impacts would be the same as Alternative 1 throughout the rest of the Project Area, where impacts would be moderate to high in localized situations. |
| Visual effects of construction and operation of pipelines, power | Long, linear facilities (roads and pipeline construction) would be | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts would be slightly greater in the western portion of the | Impacts would be less than Alternative 1 because of fewer | Impacts similar to Alternative 3. | Impacts would be the least of all alternatives because of the least |

### Table 2-12 Summary of Effects, by Alternative

| | Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| **ISSUE** | | | | | | | |
| lines, fences, and roads. | more noticeable than short or curved facilities following terrain features. These facilities would be most noticeable at short distances in the western portion of the Project Area because of the population density. However, linear features on elevated terrain in the eastern portion of the Project Area would also be easily seen from all elevations except where topography would screen these features. | | | Project Area because of more development. | facilities. | | number of linear facilities. |
| Visual effects of flaring, | Typically, a CBM well would be flared for 3 to 5 days. Without topographic or vegetative screening, the flare would be seen at distances to 3 miles and sometime more. A reflection on low clouds would make the effect more noticeable. It is assumed that 1 to 3 wells would be flared at any time. Impacts would be temporary and low. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | More wells would be flared than under the other alternatives. Therefore, the visual effects would be more widespread but still temporary and low. | Impacts similar to Alternative 1 except no wells would be drilled or flared in the HD Mountains Inventoried Roadless Area. | Impacts would be slightly less than Alternative 1 because it is assumed that fewer than three wells would be flared at any time. | Impacts similar to Alternative 1 throughout the west side of the project area. No impact within the National Forest portion of the Project Area, with exception of Sauls Creek where limited additional development would occur on private land. |
| Visual consequences of nighttime lighting of compressor stations. | Fourteen new compressor stations would be lighted with downward-directed light that would diminish the night shine from these facilities. However, the stations would be visible at night especially for nearby residents. Impacts would be localized and moderate. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Seventeen new compressor stations would be lighted with downward-directed light that would diminish the night shine from these facilities. However, the stations would be visible at night especially for nearby residents. Impacts would be localized and moderate. | Ten new compressor stations would be lighted with downward-directed light that would diminish the night shine from these facilities. Impacts would be localized and moderate. | Six new compressor stations would be lighted with downward-directed light that would diminish the night shine from these facilities. Impacts would be localized and moderate. | Five new compressor stations would be lighted with downward-directed light that would diminish the night shine from these facilities. Impacts would be localized and moderate. |
| **Noise** | | | | | | | |
| Impact of day and nighttime noise levels associated with construction, drilling, and operation of CBM facilities. | Construction noise levels would be below Colorado Oil and Gas Conservation Commission (COGCC) standards 100 feet from the activities. Construction would occur only during daytime hours. Drilling noise would be below COGCC standards at 1,800 feet during the day and 3,000 feet during the night. Pump jack noise would be below COGCC noise standards at 150 feet during the day and 375 feet during the night. Compressor station noise would be below COGCC standards at 350 feet during the day and 650 feet during the night. Five new compressor stations could be located within 650 feet of Noise Sensitive Areas (NSAs) in the western portion of the | Impacts would be similar to Alternative 1 because CBM development would be similar in the western portion of the Project Area. Although additional compression may be required in the eastern portion of the Project Area, these facilities would not affect NSAs. | Impacts similar to Alternative 1 because CBM development would be similar in the western portion of the Project Area. Although additional compression may be required in the eastern portion of the Project Area, these facilities would not affect NSAs. | Five new compressor stations could be within 650 feet of noise sensitive areas in the western portion of the Project Area. Additional setbacks from these NSAs may be required. In addition, 95 pump jacks could permanently operate near established or proposed residential areas. Additional setbacks may be required to meet COGCC noise standards. | Impacts similar to Alternative 1. | In total, 52 pump jacks could permanently operate near established or proposed residential areas. Additional setbacks may be required to meet COGCC noise standards. Four new compressor stations could be within 650 feet of NSAs in the western portion of the Project Area. Additional setbacks from these NSAs may be required. | In total, 52 pump jacks could permanently operate near established or proposed residential areas. Additional setbacks may be required to meet COGCC noise standards. Three new compressor stations could be within 650 feet of NSAs in the western portion of the Project Area. Additional setbacks from these NSAs may be required. |

**Effects, by Alternative**

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| | | | |
| mpacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | There would be no impact within the national forest portion of the Project Area, but impacts similar to Alternative 1 within the rest of the Project Area. |
| | | | |
| mpacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |
| mpacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |
| mpacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |
| t is estimated that La Plata ounty would receive $73 million n *ad valorem* tax over the life of | It is estimated that La Plata County would receive $32 million in *ad valorem* tax over the life of | It is estimated that La Plata County would receive $31 million in *ad valorem* tax over the life of | It is estimated that La Plata County would receive $23 million in *ad valorem* tax over the life of |

| | | | |
|---|---|---|---|
| | | | |
| | | | |
| | 1 | | 5 |
| **ISSUE** | | | |
| Effect on sales and taxes. | County would receive $33 m over the life of the project, ar Archuleta County would rece $17 million. Sales tax reven would be minimal because m of the purchases of CBM equipment and personal purchases by employees wou outside of the counties. | , and Archuleta County ive $6 million. Sales es would be minimal ost of the purchases of pment and personal by employees would be the counties. | the project, and Archuleta County would receive $2 million. Sales tax revenues would be minimal because most of the purchases of CBM equipment and personal purchases by employees would be outside of the counties. |
| Impacts of CBM development on demographics, employment, and infrastructure. | Employment associated with CBM development would be percent of total employment. With 930 new jobs, the population increase would be insignificant. | nt associated with lopment would only be f total employment. ew jobs, the increase would be nt. See previous issue s for cost estimates. | Employment associated with CBM development would only be 2 percent of total employment. With 380 new jobs, the population increase would be insignificant. See previous issue discussions for cost estimates. |
| Effect of gas wells on residential property values. | Property values have increase about 7 percent per year duri the past decade. Although so property values may decrease close proximity to wells, they would be expected to increas value after the life of the proj at the same relative rate as properties distant from wells. | ilar to Alternative 1. | Effects similar to Alternative 1. |
| **Health and Safety** | | | |
| Risks to human health associated with underground coal fires. | Risk of ignition or re-ignition coal fires would be low to moderate. | milar to Alternative 1. | Impacts similar to Alternative 1. |
| Health risks of hydrogen sulfide seeps. | Since the overwhelming majo of existing CBM wells do not contain hydrogen sulfide, the of exposure is extremely low. | ilar to Alternative 1. | Effects similar to Alternative 1. |
| Potential for accidental spills from generation, handling, and storage of hazardous and nonhazardous chemicals and wastes. | The risk of a spill would be proportional to the amount of chemicals and hazardous materials transported, stored, used. The operator's adheren regulations and their environmental health and saf plans would minimize the potential for spills. | ilar to Alternative 1 ally less because of s. | Effects similar to Alternative 1 but less because of fewer wells. |
| Effects of chemicals used as treatments for project roads (magnesium chloride). | The State of Colorado and U. Environmental Protection Ag (EPA) have approved applica of magnesium chloride for du suppression on roads. Becau adverse health effects from magnesium chloride have bee noted, the benefits of dust suppression far outweighs an minimal adverse effect of magnesium chloride. | ilar to Alternative 1. | Effects similar to Alternative 1. |
| Risks of well flaring. | Flaring increased the risk for fires when compared with ve | ilar to Alternative 1. | Effects similar to Alternative 1. |

### Table 2-12 Summary of Effects, by Alternative

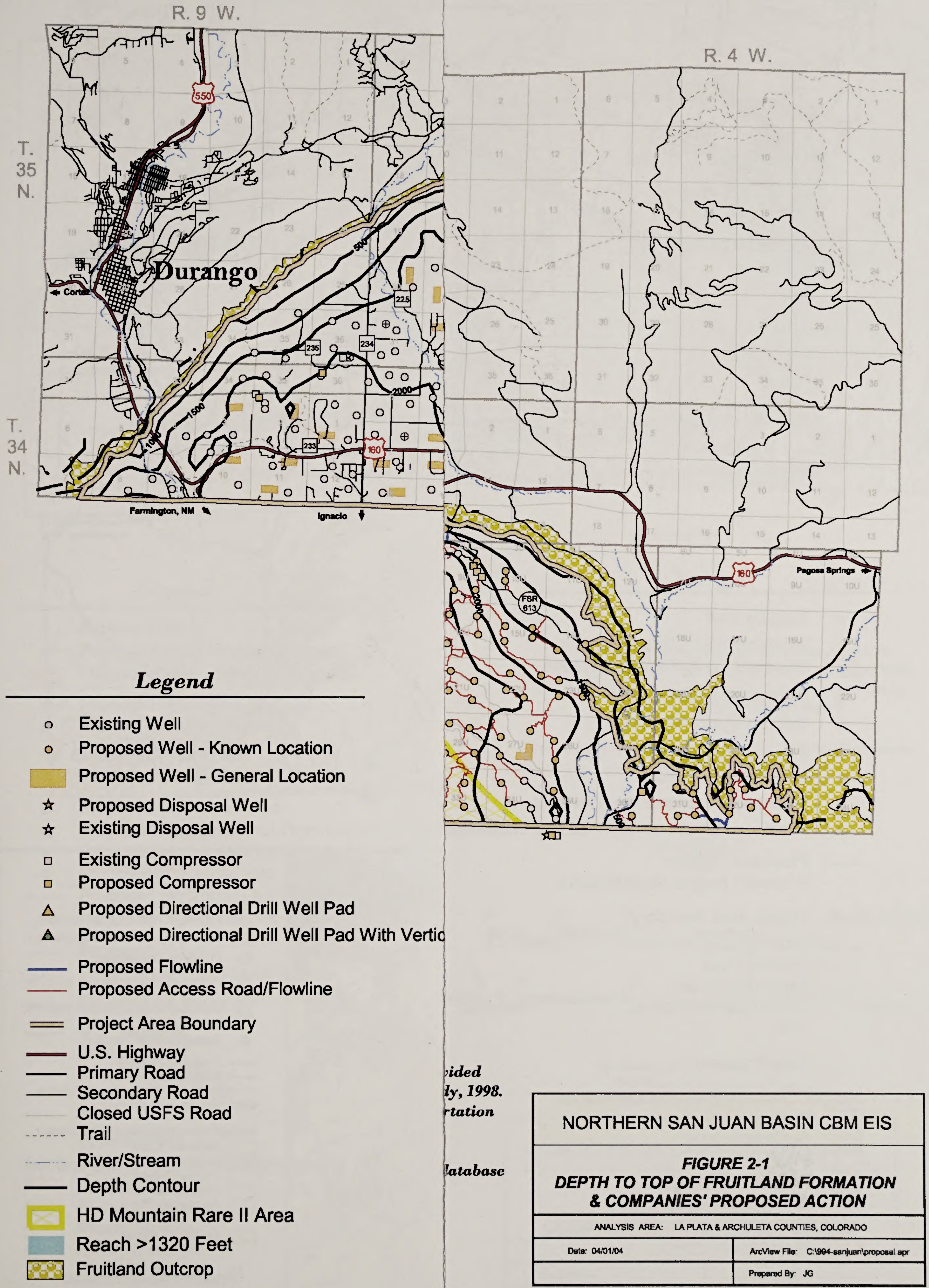
| | Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| **ISSUE** | | | | | | | |
| | Project Area. Additional setbacks from these NSAs may be required. In addition, 69 pump jacks could operate near established or proposed residential areas. Additional setbacks may be required to meet COGCC noise standards. | | | | | | |
| | | | | | | | |
| Effect of cavitation and fracturing operations on sensitive receptors such as outdoor living space around residences. | One hundred percent of wells would be fracture stimulated in the eastern portion of the Project Area. On the western side, 75 percent of the wells would be fractured and 25 percent cavitated to stimulate production. Noise effects from fracturing would not be noticeable because of the depth of this activity. However, short bursts of noise would be noticeable from cavitation, but this impact would be experienced over a 2-week period for any given site and only during the day. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | There would be no impact within the national forest portion of the Project Area, but impacts similar to Alternative 1 within the rest of the Project Area. |
| **Social and Economic** | | | | | | | |
| Impacts of CBM development on tourism and tourism revenues and the sales tax revenue, employment, and income tax proceeds derived from tourism. | CBM and conventional gas development has not affected tourism and is unlikely to affect tourism during the life of the project. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |
| Potential for creating a boom or bust economy. | Revenues, jobs, and personal income would likely peak by the year 2010 and gradually decline until gas production ends about 2035. Although CBM revenues and jobs would gradually decrease, the population is projected to steadily grow. The two counties could direct some of the gas revenues toward future years. Long-term growth and diversification would likely somewhat offset the gradual decline in CBM revenues. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |
| Environmental costs of drilling on federal lands. | Environmental effects are described throughout the EIS. Industry profits accrue from the sale of natural gas minus the expenses to explore, drill, and extract CBM gas. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |
| Impact of continued CBM development on county revenues from gas royalties and taxes. | County revenues would be in the form of *ad valorem* property taxes. It is estimated that La Plata | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | It is estimated that La Plata County would receive $73 million in *ad valorem* tax over the life of | It is estimated that La Plata County would receive $32 million in *ad valorem* tax over the life of | It is estimated that La Plata County would receive $31 million in *ad valorem* tax over the life of | It is estimated that La Plata County would receive $23 million in *ad valorem* tax over the life of |

## Table 2-12 Summary of Effects, by Alternative

| | Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| **ISSUE** | | | | | | | |
| Effect on sales and taxes. | County would receive $33 million over the life of the project, and Archuleta County would receive $17 million. Sales tax revenues would be minimal because most of the purchases of CBM equipment and personal purchases by employees would be outside of the counties. | | | the project, and Archuleta County would receive $23 million. Sales tax revenues would be minimal because most of the purchases of CBM equipment and personal purchases by employees would be outside of the counties. | the project, and Archuleta County would receive $8 million. Sales tax revenues would be minimal because most of the purchases of CBM equipment and personal purchases by employees would be outside of the counties. | the project, and Archuleta County would receive $6 million. Sales tax revenues would be minimal because most of the purchases of CBM equipment and personal purchases by employees would be outside of the counties. | the project, and Archuleta County would receive $2 million. Sales tax revenues would be minimal because most of the purchases of CBM equipment and personal purchases by employees would be outside of the counties. |
| Impacts of CBM development on demographics, employment, and infrastructure. | Employment associated with CBM development would be 2 percent of total employment. With 930 new jobs, the population increase would be insignificant. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Employment associated with CBM development would only be 2 percent of total employment. With 1,630 new jobs, the population increase would be insignificant. See previous issue discussions for cost estimates. | Employment associated with CBM development would only be 2 percent of total employment. With 670 new jobs, the population increase would be insignificant. See previous issue discussions for cost estimates. | Employment associated with CBM development would only be 2 percent of total employment. With 600 new jobs, the population increase would be insignificant. See previous issue discussions for cost estimates. | Employment associated with CBM development would only be 2 percent of total employment. With 380 new jobs, the population increase would be insignificant. See previous issue discussions for cost estimates. |
| Effect of gas wells on residential property values. | Property values have increased by about 7 percent per year during the past decade. Although some property values may decrease in close proximity to wells, they would be expected to increase in value after the life of the project at the same relative rate as properties distant from wells. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. |
| **Health and Safety** | | | | | | | |
| Risks to human health associated with underground coal fires. | Risk of ignition or re-ignition of coal fires would be low to moderate. | Risk would be minimally less than Alternative 1 because of 12 fewer wells. | Risk would be less than Alternative 1A because of 52 fewer wells. | Risk would be moderate because of larger number of wells and the wells near the outcrop. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. | Impacts similar to Alternative 1. |
| Health risks of hydrogen sulfide seeps. | Since the overwhelming majority of existing CBM wells do not contain hydrogen sulfide, the risk of exposure is extremely low. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Because of the wells proposed near the outcrop, the risk would be rated marginally higher than Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. |
| Potential for accidental spills from generation, handling, and storage of hazardous and nonhazardous chemicals and wastes. | The risk of a spill would be proportional to the amount of chemicals and hazardous materials transported, stored, and used. The operator's adherence to regulations and their environmental health and safety plans would minimize the potential for spills. | Effects similar to Alternative 1 but marginally less because of fewer wells. | Effects similar to Alternative 1 but marginally less because of fewer wells. | Effects similar to Alternative 1 but marginally higher because of more wells. | Effects similar to Alternative 1 but marginally less because of fewer wells. | Effects similar to Alternative 1 but marginally less because of fewer wells. | Effects similar to Alternative 1 but less because of fewer wells. |
| Effects of chemicals used as treatments for project roads (magnesium chloride). | The State of Colorado and U.S. Environmental Protection Agency (EPA) have approved application of magnesium chloride for dust suppression on roads. Because no adverse health effects from magnesium chloride have been noted, the benefits of dust suppression far outweighs any minimal adverse effect of magnesium chloride. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. |
| Risks of well flaring. | Flaring increased the risk for wild fires when compared with venting | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. |

## f Effects, by Alternative

| ative | | | |
|---|---|---|---|
| 2 | 3 | 4 | 5 |
| | | | |
| | | | |
| Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. |
| | | | |
| No significant, adverse impacts to ir quality are anticipated from mplementation of Alternative 2. Although the restrictive State of Colorado's 3-hr sulfur dioxide standard of 700 $\mu g/m^3$ was predicted to be exceeded (at 702 $\mu g/m^3$) during construction, given the "reasonable, but conservative" assumptions applied in this analysis, no violations of any applicable local, state, tribal or federal ambient air quality standard are likely to actually occur. Applicable PSD Class I and II increments were not predicted to be exceeded. Potential atmospheric deposition impacts (and resulting changes in sensitive lake chemistry) were predicted to be below applicable thresholds. A direct 'just noticeable change" in visibility was not predicted to occur at Mesa Verde National Park on any day, but would occur on between ) and 3 days per year at the Weminuche Wilderness Area. However, given the "reasonable, but conservative" assumptions ncorporated into this analysis, hese direct impacts are not likely o actually occur. | No significant, adverse impacts to air quality are anticipated from implementation of Alternative 3. Given the lower number of potential well pad and compressor station locations, overall air quality impacts would be less than those described under Alternative 1. | No significant, adverse impacts to air quality are anticipated from implementation of Alternative 4. Given the lower number of potential well pad and compressor station locations, overall air quality impacts would be less than those described under Alternative 1. | No significant, adverse impacts to air quality are anticipated from implementation of Alternative 5 |



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NORTHERN SAN JUAN BASIN CBM EIS

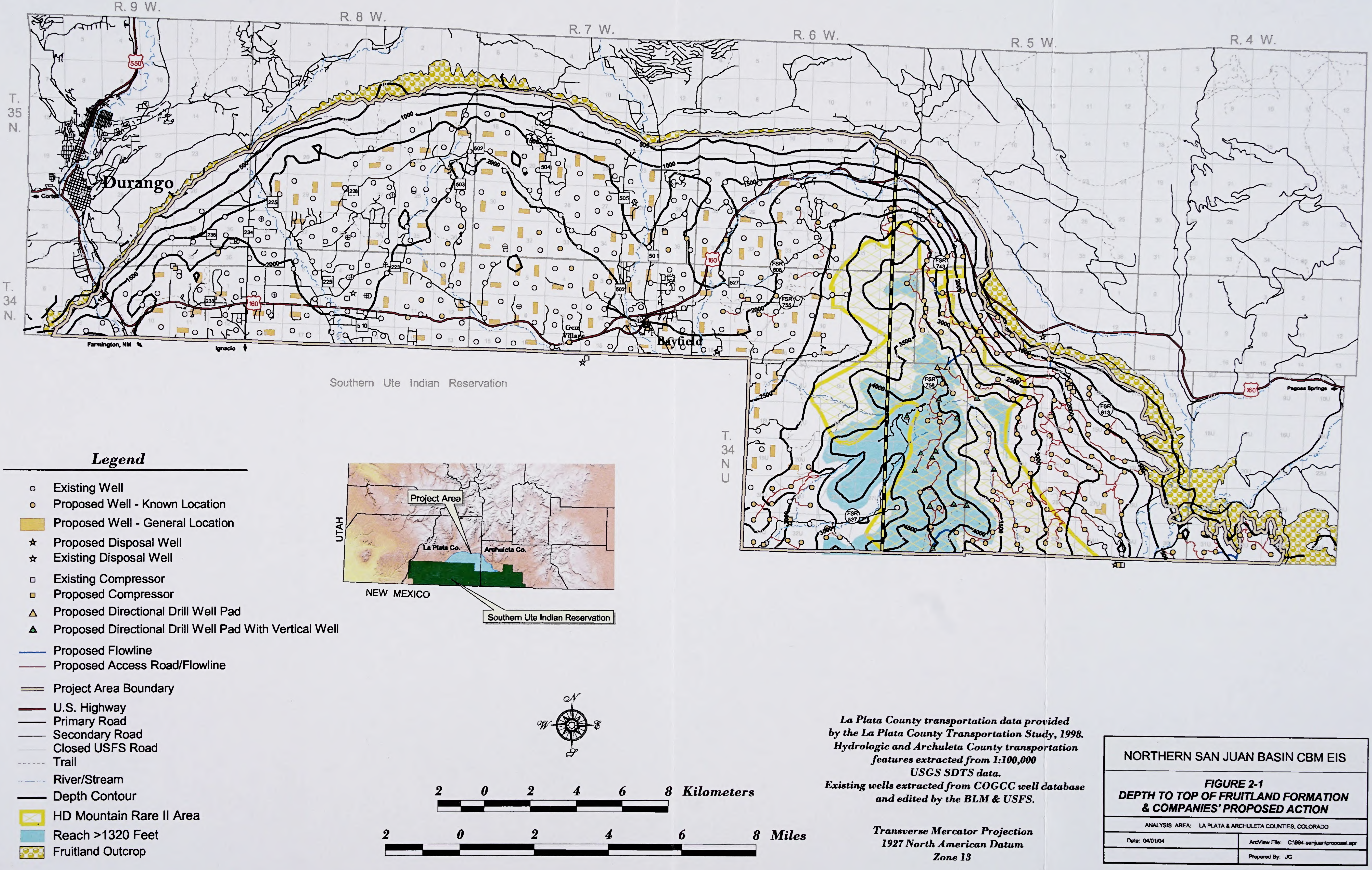
***FIGURE 2-1***
***DEPTH TO TOP OF FRUITLAND FORMATION***
***& COMPANIES' PROPOSED ACTION***

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

| Date: 04/01/04 | ArcView File: C:\994-sanjuan\proposal.apr |
|---|---|
| | Prepared By: JG |

## Table 2-12 Summary of Effects, by Alternative

| | Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| **ISSUE** | | | | | | | |
| | methane. Clearing brush and vegetation near flaring reduces the risk for fires. During periods of high fire risk, the agencies issue strict fire prevention that further reduces the risk of fire. | | | | | | |
| Potential for fire or explosion of CBM wells. | Standard safety procedures for drilling, pipeline route markers, monitoring, and inspections are required to minimize the probability of a well blowout, undetected gas leak, or well fire. Adherence to these procedures and development of emergency plans with defined fire prevention and fire fighting procedures minimize the risk. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | Effects similar to Alternative 1. |
| **Air Quality** | | | | | | | |
| The effect of additional CBM development on air quality. | No significant, adverse impacts to air quality are anticipated from implementation of Alternative 1. Although the restrictive State of Colorado's 3-hr sulfur dioxide standard of 700 μg/m$^3$ was predicted to be exceeded (at 702 μg/m$^3$) during construction, given the "reasonable, but conservative" assumptions applied in this analysis, no violations of any applicable local, state, tribal or federal ambient air quality standard are likely to actually occur.<br>Applicable PSD Class I and II increments were not predicted to be exceeded. Potential atmospheric deposition impacts (and resulting changes in sensitive lake chemistry) were predicted to be below applicable thresholds. A direct 'just noticeable change" in visibility was not predicted to occur at Mesa Verde National Park on any day, but would occur on between 0 and 3 days per year at the Weminuche Wilderness Area. However, given the "reasonable, but conservative" assumptions incorporated into this analysis, these direct impacts are not likely to actually occur. | Effects similar to Alternative 1. | Effects similar to Alternative 1. | No significant, adverse impacts to air quality are anticipated from implementation of Alternative 2. Although the restrictive State of Colorado's 3-hr sulfur dioxide standard of 700 μg/m$^3$ was predicted to be exceeded (at 702 μg/m$^3$) during construction, given the "reasonable, but conservative" assumptions applied in this analysis, no violations of any applicable local, state, tribal or federal ambient air quality standard are likely to actually occur. Applicable PSD Class I and II increments were not predicted to be exceeded.<br>Potential atmospheric deposition impacts (and resulting changes in sensitive lake chemistry) were predicted to be below applicable thresholds. A direct 'just noticeable change" in visibility was not predicted to occur at Mesa Verde National Park on any day, but would occur on between 0 and 3 days per year at the Weminuche Wilderness Area. However, given the "reasonable, but conservative" assumptions incorporated into this analysis, these direct impacts are not likely to actually occur. | No significant, adverse impacts to air quality are anticipated from implementation of Alternative 3. Given the lower number of potential well pad and compressor station locations, overall air quality impacts would be less than those described under Alternative 1. | No significant, adverse impacts to air quality are anticipated from implementation of Alternative 4. Given the lower number of potential well pad and compressor station locations, overall air quality impacts would be less than those described under Alternative 1. | No significant, adverse impacts to air quality are anticipated from implementation of Alternative 5 |



*La Plata County transportation data provided by the La Plata County Transportation Study, 1998. Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data. Existing wells extracted from COGCC well database and edited by the BLM & USFS.*

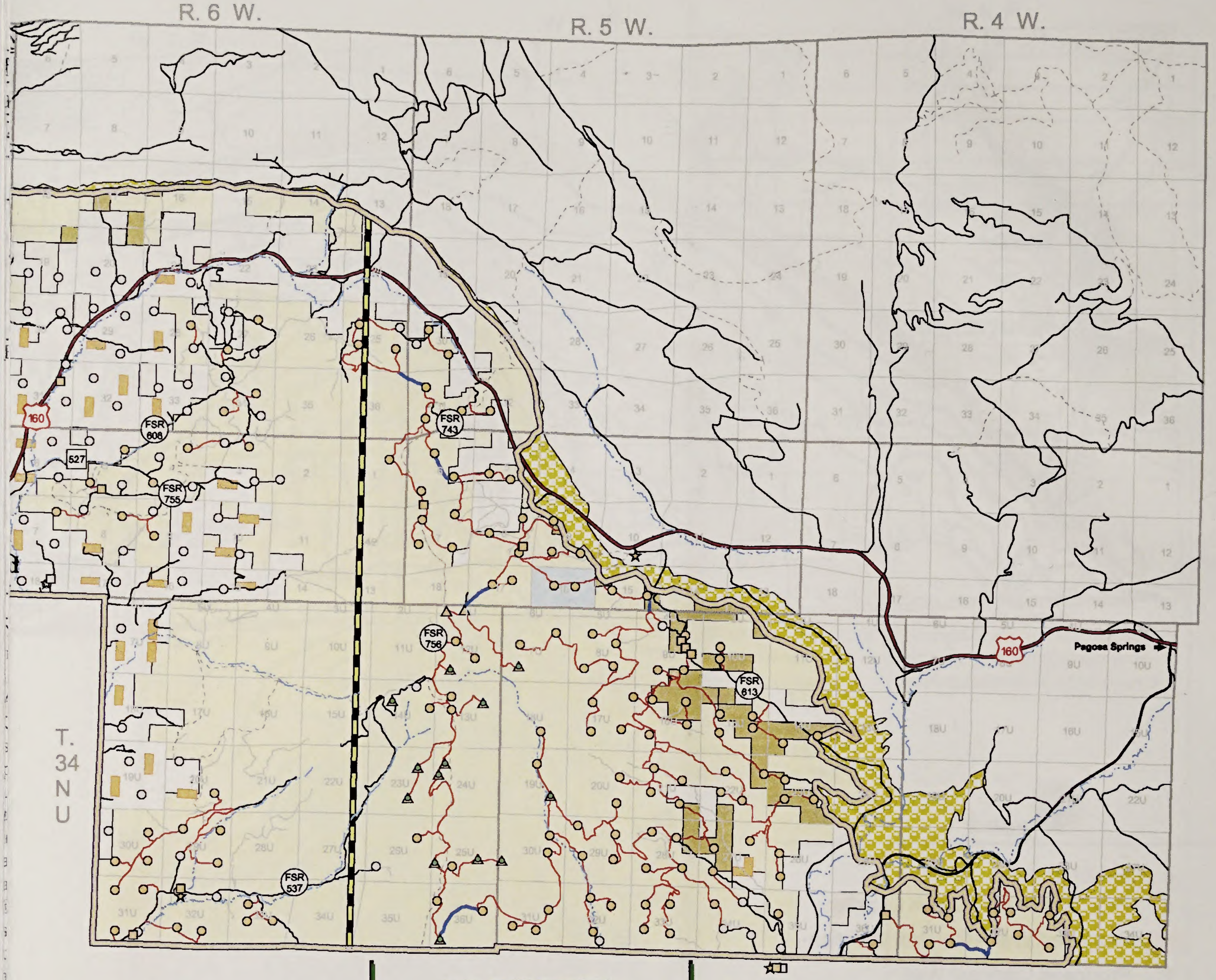
*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

NORTHERN SAN JUAN BASIN CBM EIS

***FIGURE 2-1***
***DEPTH TO TOP OF FRUITLAND FORMATION & COMPANIES' PROPOSED ACTION***

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

| | |
|---|---|
| Date: 04/01/04 | ArcView File: C:\994-sanjuan\proposal.apr |
| | Prepared By: JG |


R. 6 W.
R. 5 W.
R. 4 W.
T. 34 N U
160
FSR 608
527
FSR 755
FSR 743
FSR 756
FSR 613
FSR 537
Pagosa Springs

INSET

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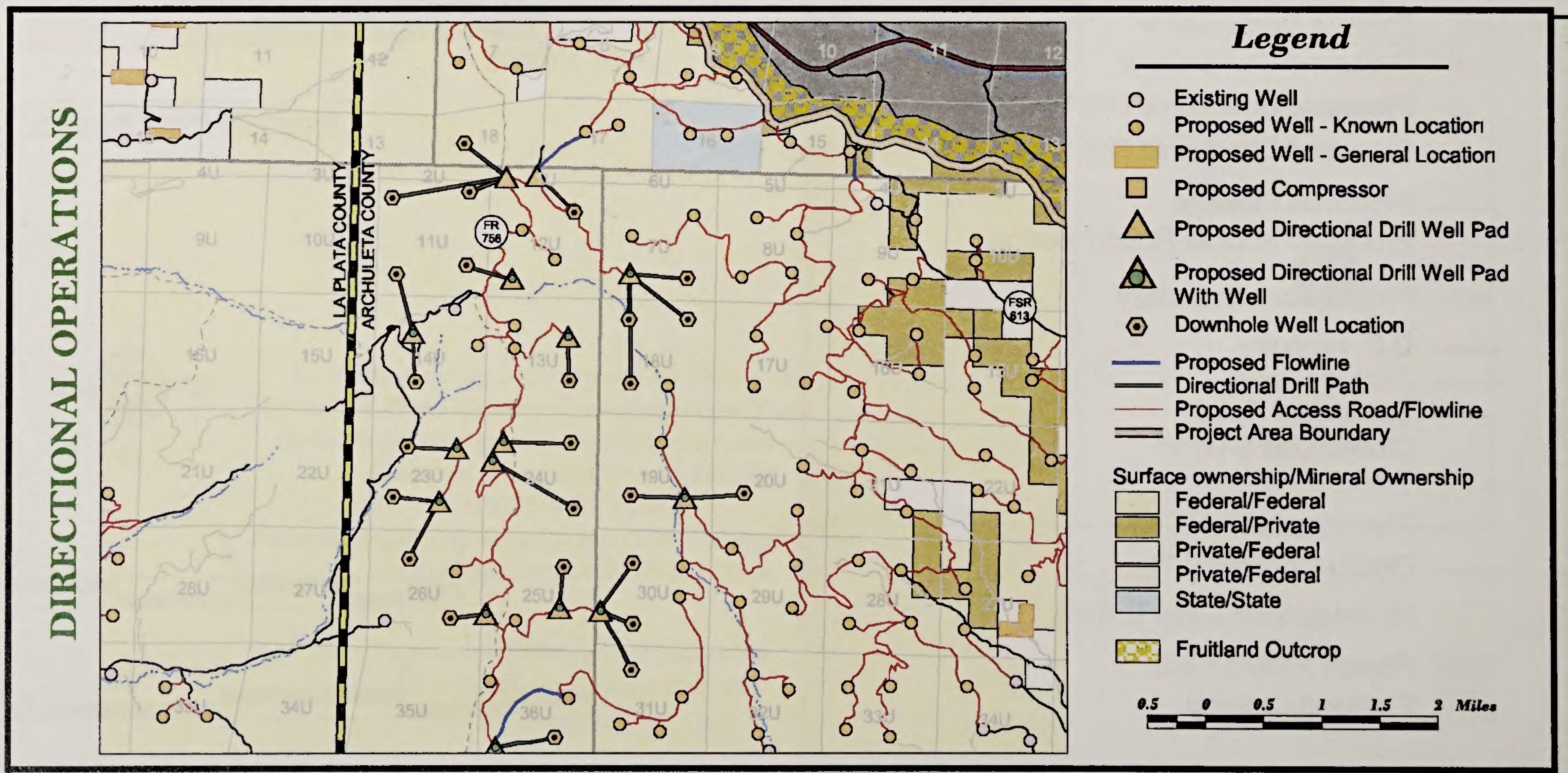
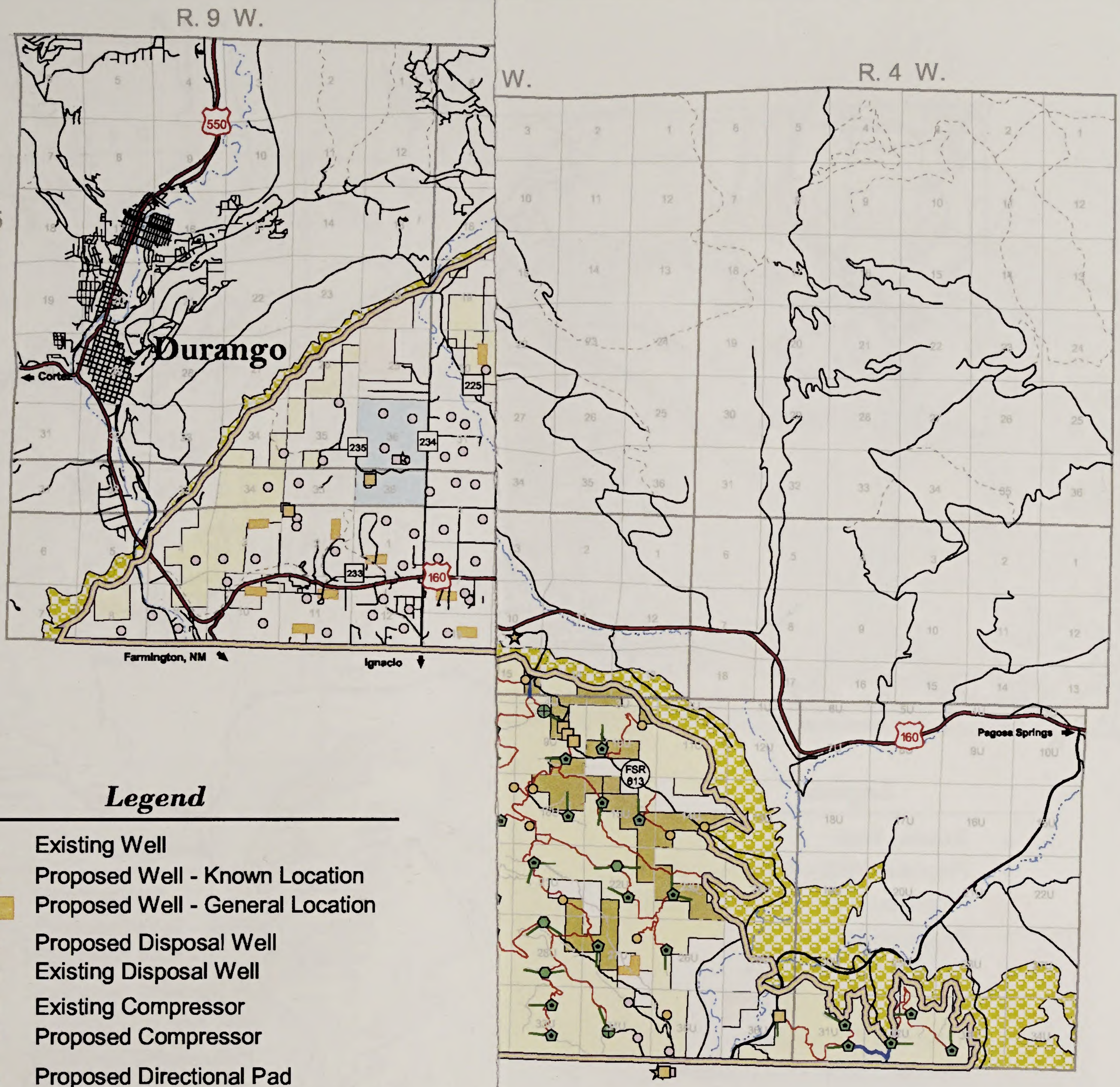

DIRECTIONAL OPERATIONS
LA PLATA COUNTY
ARCHULETA COUNTY
FR 756
FSR 613
Legend
Existing Well
Proposed Well - Known Location
Proposed Well - General Location
Proposed Compressor
Proposed Directional Drill Well Pad
Proposed Directional Drill Well Pad With Well
Downhole Well Location
Proposed Flowline
Directional Drill Path
Proposed Access Road/Flowline
Project Area Boundary
Surface ownership/Mineral Ownership
Federal/Federal
Federal/Private
Private/Federal
Private/Federal
State/State
Fruitland Outcrop
0.5
0
0.5
1
1.5
2 Miles



## Legend

- ○ Existing Well
- ● Proposed Well - Known Location
- ▬ Proposed Well - General Location
- ☆ Proposed Disposal Well
- ☆ Existing Disposal Well
- □ Existing Compressor
- ■ Proposed Compressor
- ⬢ Proposed Directional Pad
- ⊕ Proposed Horizontal Pad From Existing Well
- ⬟ Proposed Horizontal Pad with Vertical Well
- ⬢ Proposed Horizontal Pad
- — Proposed Horizontal Drill Path
- — Proposed Directional Drill Path
- — Proposed Flowline
- — Proposed Access Road/Flowline
- ═ Project Area Boundary
- — U.S. Highway
- — Primary Road
- — Secondary Road
- — Closed USFS Road
- ----- Trail
- -·-·- River/Stream

Surface Ownership/Mineral Ownership

- ▨ Federal/Federal
- ▨ Federal/Private
- ☐ Private/Private
- ☐ Private/Federal
- ▨ State/State
- ▨ Fruitland Outcrop

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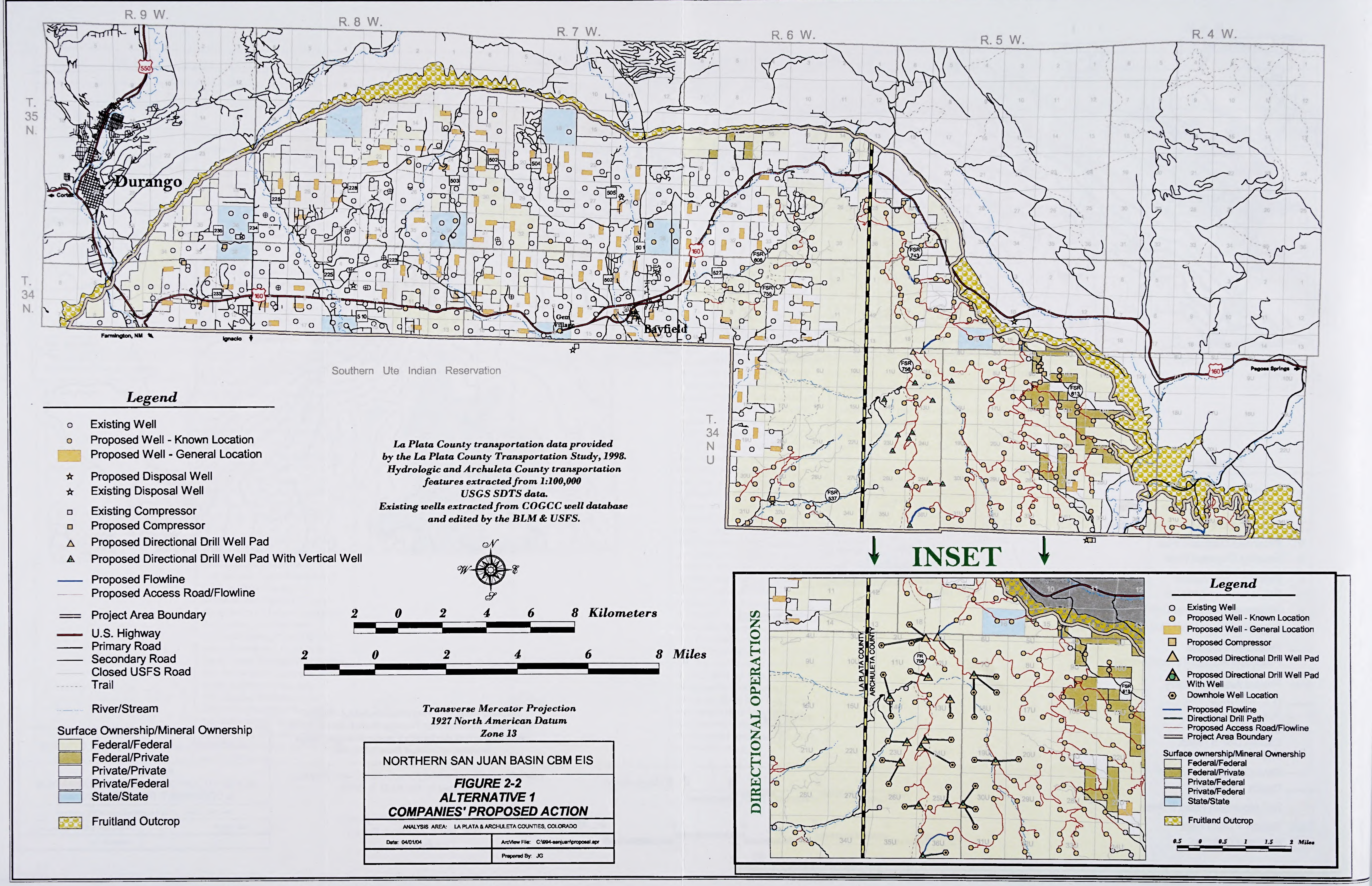
NORTHERN SAN JUAN BASIN CBM EIS

**FIGURE 2-3**
**ALTERNATIVE 1A**
**BLM/FS PREFERRED ALTERNATIVE**

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

Date: 04/01/04
ArcView File: C:\994-sanjuan\proposal.apr
Prepared By: JG



*La Plata County transportation data provided by the La Plata County Transportation Study, 1998. Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data. Existing wells extracted from COGCC well database and edited by the BLM & USFS.*

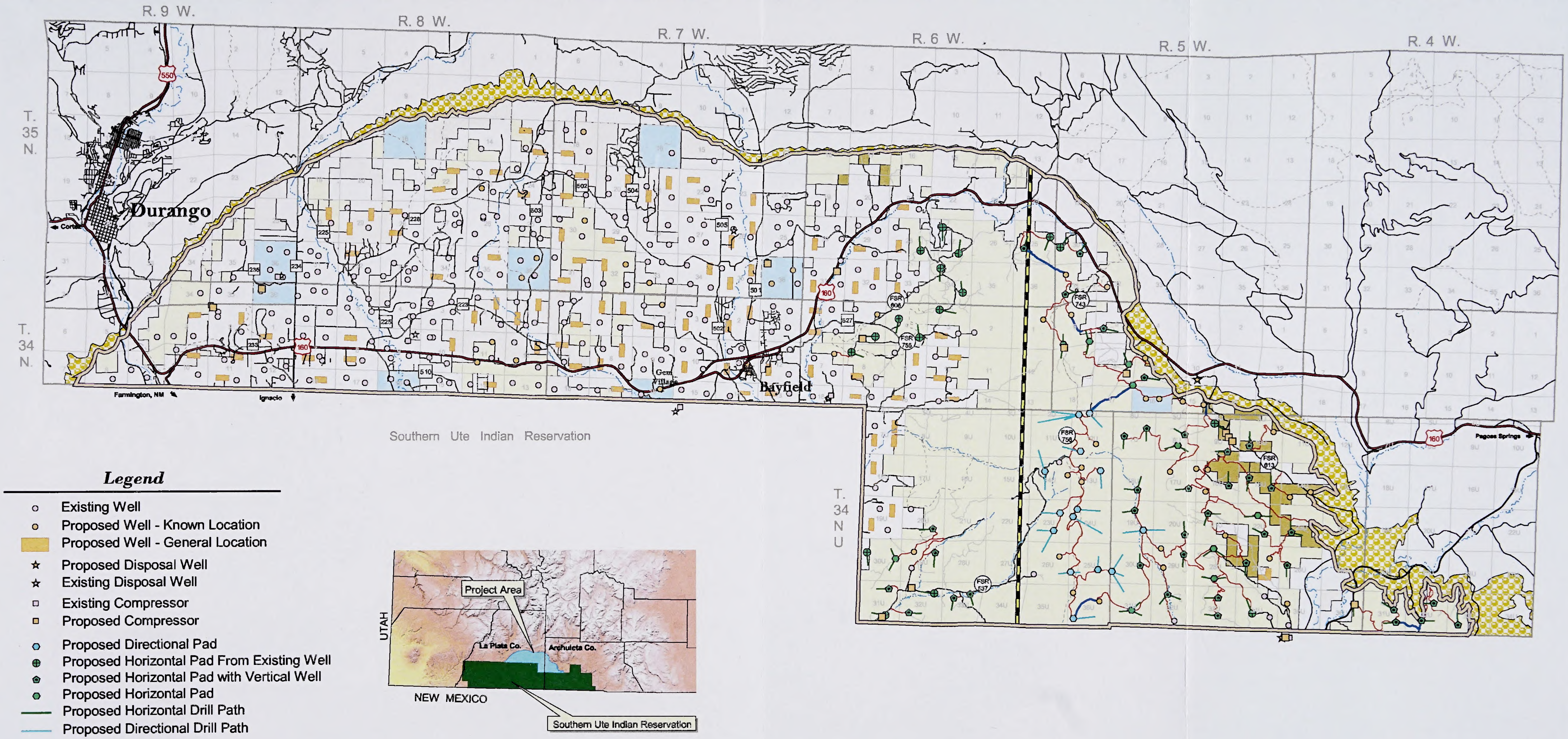
*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

NORTHERN SAN JUAN BASIN CBM EIS

**FIGURE 2-2**
**ALTERNATIVE 1**
**COMPANIES' PROPOSED ACTION**

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

Date: 04/01/04
ArcView File: C:\994-sanjuan\proposal.apr
Prepared By: JG



## *Legend*

- ○ Existing Well
- ● Proposed Well - Known Location
- ▬ Proposed Well - General Location
- ☆ Proposed Disposal Well
- ★ Existing Disposal Well
- □ Existing Compressor
- ■ Proposed Compressor
- ● Proposed Directional Pad
- ⊕ Proposed Horizontal Pad From Existing Well
- ⬟ Proposed Horizontal Pad with Vertical Well
- ● Proposed Horizontal Pad
- — Proposed Horizontal Drill Path
- — Proposed Directional Drill Path
- — Proposed Flowline
- — Proposed Access Road/Flowline
- ═ Project Area Boundary
- — U.S. Highway
- — Primary Road
- — Secondary Road
- — Closed USFS Road
- ---- Trail
- -·- River/Stream

Surface Ownership/Mineral Ownership

- ▢ Federal/Federal
- ▨ Federal/Private
- ▢ Private/Private
- ▢ Private/Federal
- ▢ State/State
- ▩ Fruitland Outcrop

2 0 2 4 6 8 Kilometers

2 0 2 4 6 8 Miles

*La Plata County transportation data provided by the La Plata County Transportation Study, 1998. Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data. Existing wells extracted from COGCC well database and edited by the BLM & USFS.*

*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

NORTHERN SAN JUAN BASIN CBM EIS

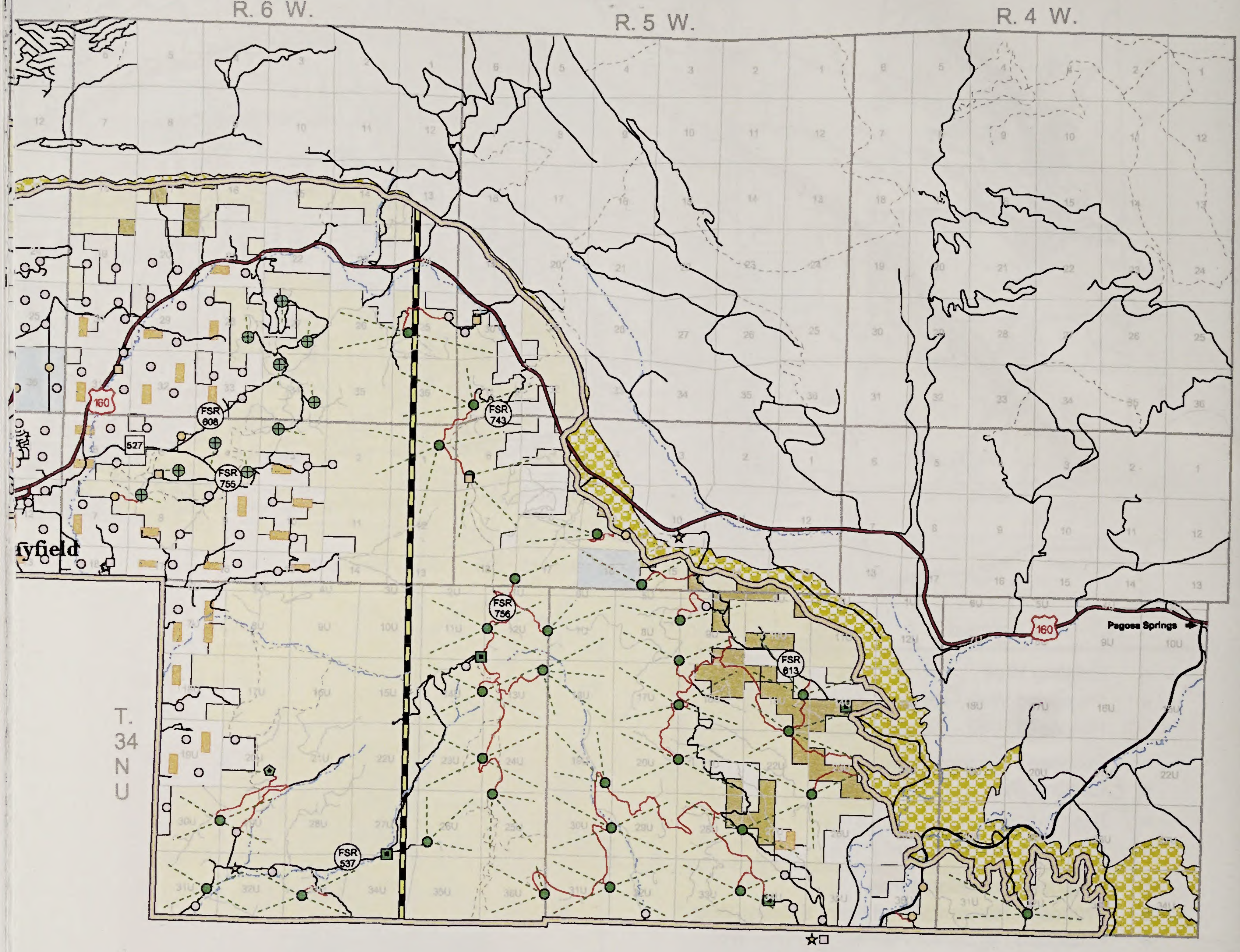
### *FIGURE 2-3*
### *ALTERNATIVE 1A*
### *BLM/FS PREFERRED ALTERNATIVE*

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

Date: 04/01/04

ArcView File: C:\894-sanjuan\proposal.apr

Prepared By: JG



Kilometers

6 8 Miles

*La Plata County transportation data provided by the La Plata County Transportation Study, 1998. Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data. Existing wells extracted from COGCC well database and edited by the BLM & USFS.*

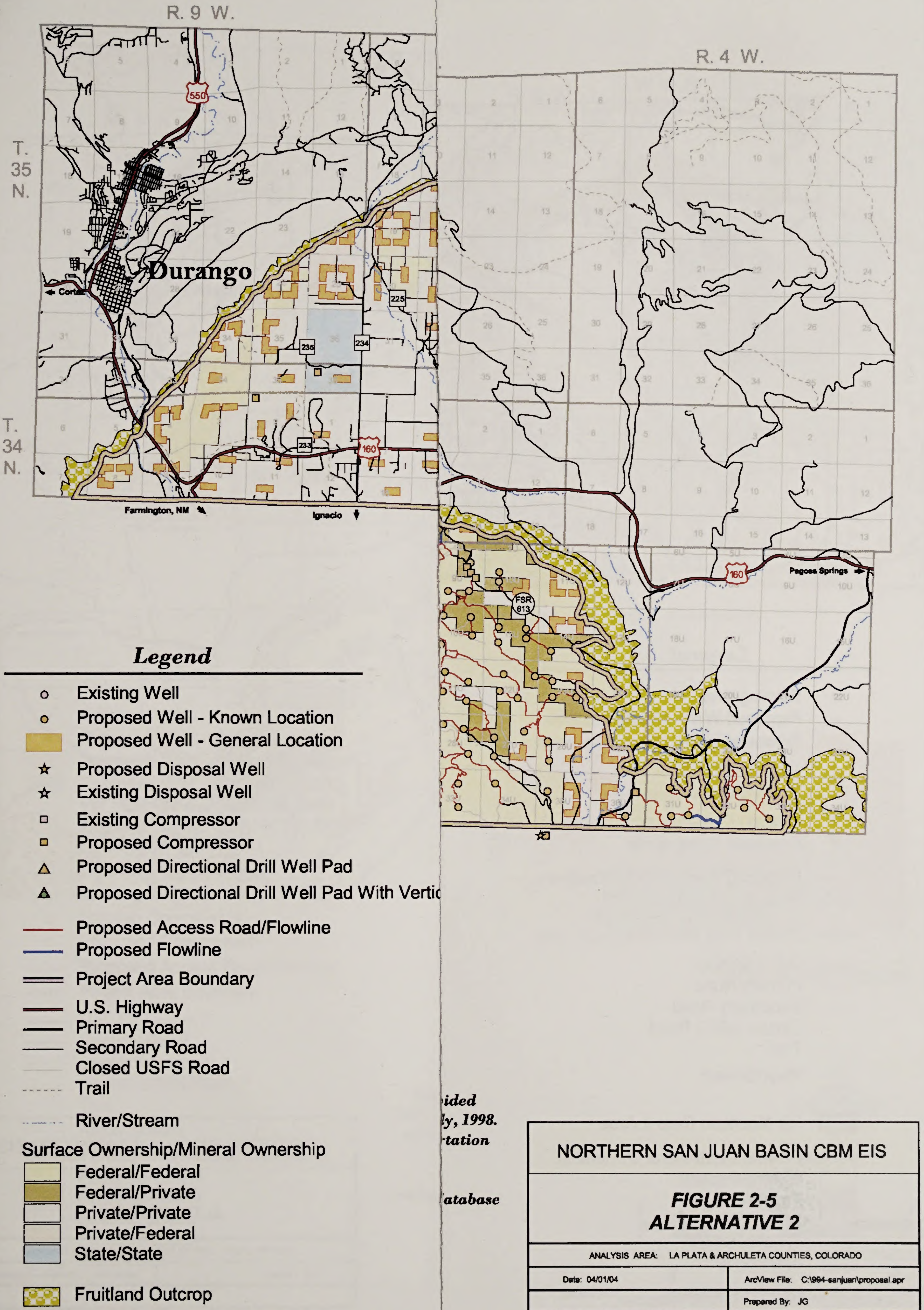
*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

NORTHERN SAN JUAN BASIN CBM EIS

## *FIGURE 2-4*
## *ALTERNATIVE 1B*

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

Date: 04/01/04
ArcView File: C:\994-sanjuan\proposal.apr
Prepared By: JG



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*tation*

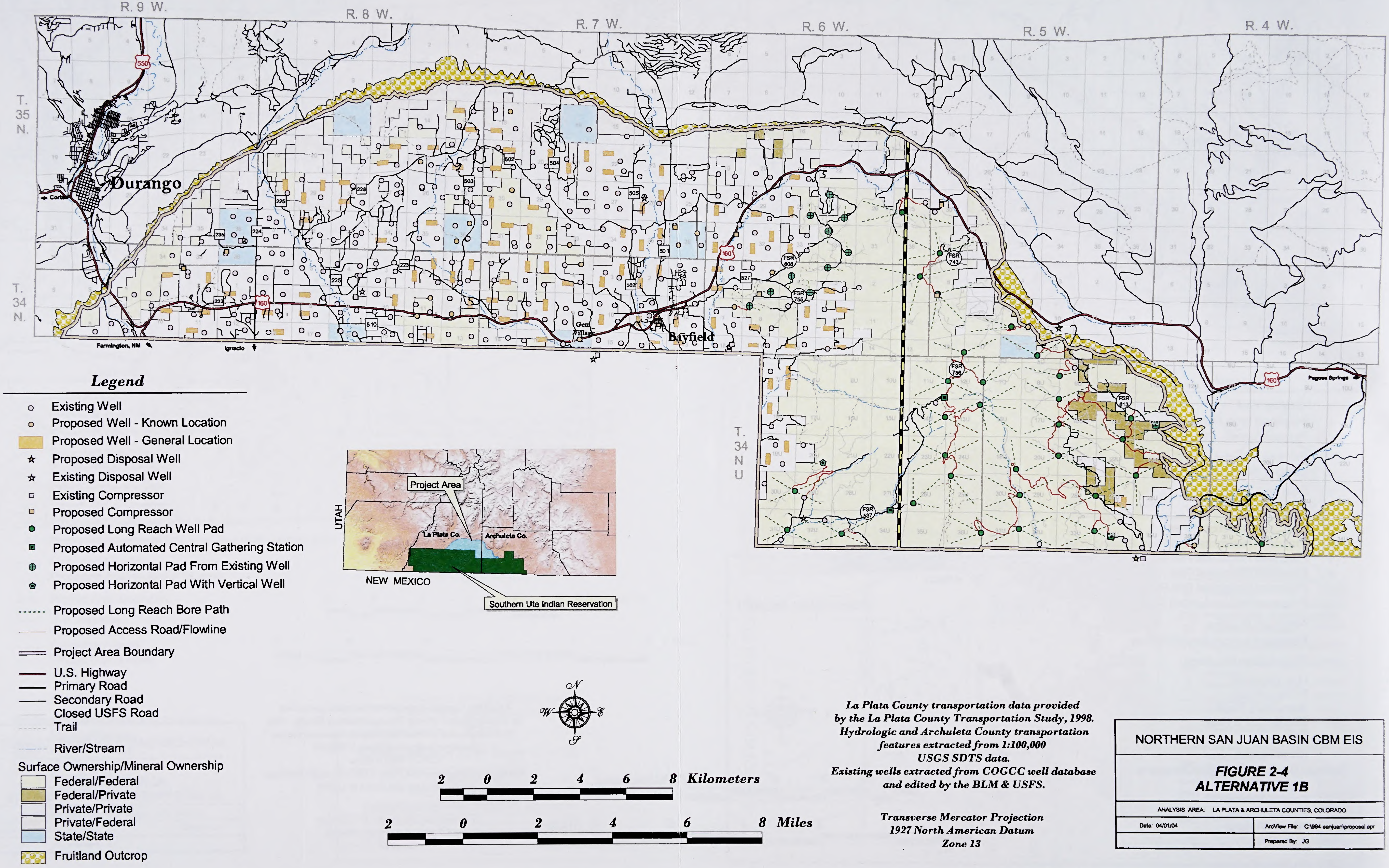
*atabase*

NORTHERN SAN JUAN BASIN CBM EIS

***FIGURE 2-5***
***ALTERNATIVE 2***

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

Date: 04/01/04
ArcView File: C:\994-sanjuan\proposal.apr
Prepared By: JG



*La Plata County transportation data provided by the La Plata County Transportation Study, 1998. Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data. Existing wells extracted from COGCC well database and edited by the BLM & USFS.*

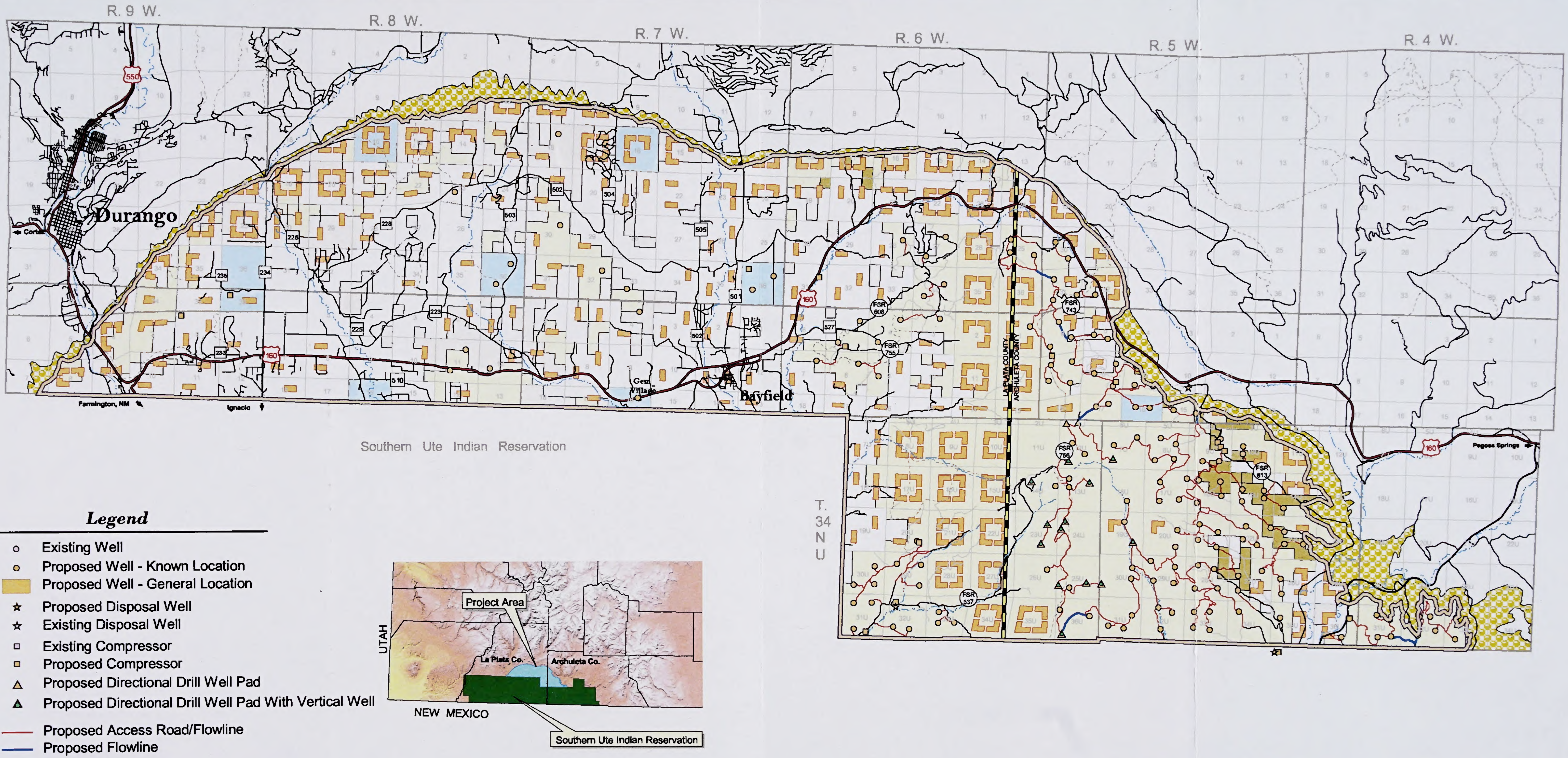
*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

NORTHERN SAN JUAN BASIN CBM EIS

**FIGURE 2-4**
**ALTERNATIVE 1B**

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

Date: 04/01/04
ArcView File: C:\994-sanjuan\proposal.apr
Prepared By: JG



## Legend

- ○ Existing Well
- ● Proposed Well - Known Location
- ▨ Proposed Well - General Location
- ★ Proposed Disposal Well
- ☆ Existing Disposal Well
- □ Existing Compressor
- ■ Proposed Compressor
- △ Proposed Directional Drill Well Pad
- ▲ Proposed Directional Drill Well Pad With Vertical Well
- — Proposed Access Road/Flowline
- — Proposed Flowline
- ═ Project Area Boundary
- — U.S. Highway
- — Primary Road
- — Secondary Road
- — Closed USFS Road
- ---- Trail
- ---- River/Stream

Surface Ownership/Mineral Ownership

- ▭ Federal/Federal
- ▨ Federal/Private
- ▭ Private/Private
- ▭ Private/Federal
- ▭ State/State
- ▨ Fruitland Outcrop

2 0 2 4 6 8 Kilometers

2 0 2 4 6 8 Miles

*La Plata County transportation data provided by the La Plata County Transportation Study, 1998. Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data. Existing wells extracted from COGCC well database and edited by the BLM & USFS.*

*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

NORTHERN SAN JUAN BASIN CBM EIS

**FIGURE 2-5**
**ALTERNATIVE 2**

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

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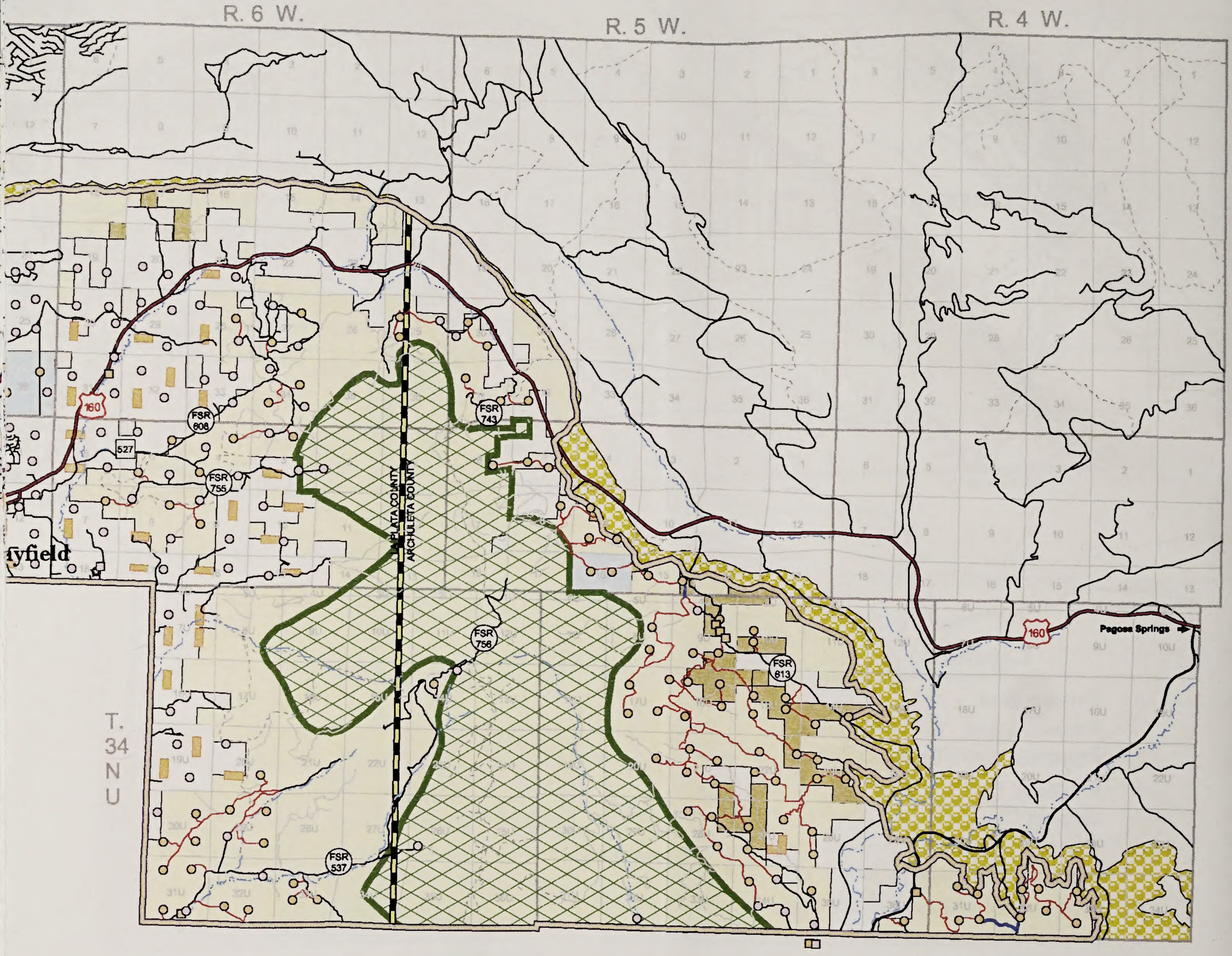
|---|---|
| Date: 04/01/04 | ArcView File: C:\994-sanjuan\proposal.apr |
| | Prepared By: JG |



*La Plata County transportation data provided by the La Plata County Transportation Study, 1998.*
*Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data.*
*Existing wells extracted from COGCC well database and edited by the BLM & USFS.*

*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

*Kilometers*

*6 8 Miles*

NORTHERN SAN JUAN BASIN CBM EIS

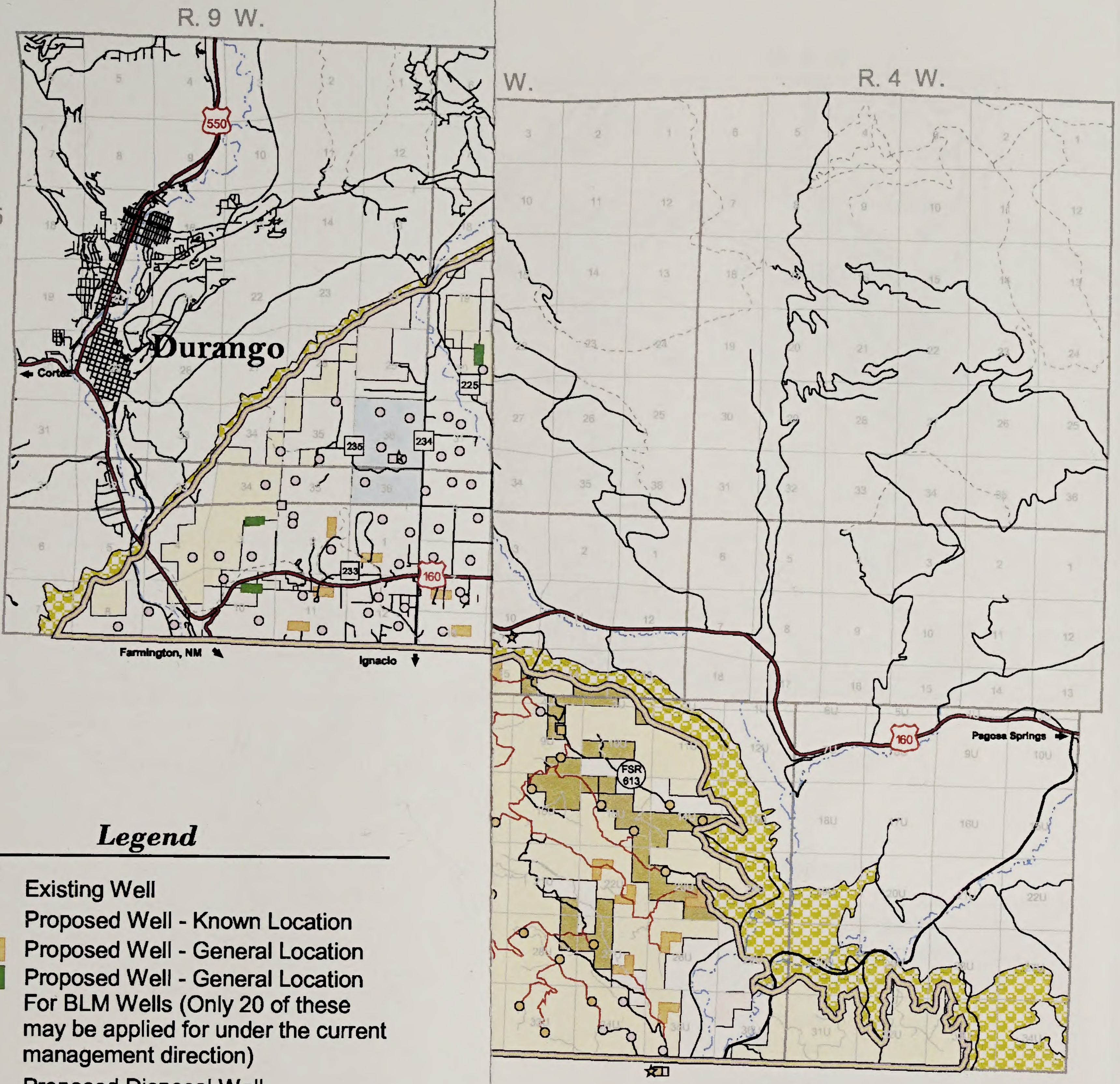
**FIGURE 2-6**
**ALTERNATIVE 3**

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

Date: 04/01/04

ArcView File: C:\994-sanjuan\proposal.apr

Prepared By: JG



## Legend

- ○ Existing Well
- ● Proposed Well - Known Location
- 🟨 Proposed Well - General Location
- 🟩 Proposed Well - General Location For BLM Wells (Only 20 of these may be applied for under the current management direction)
- ☆ Proposed Disposal Well
- ☆ Existing Disposal Well
- □ Existing Compressor
- ■ Proposed Compressor
- — Proposed Access Road/Flowline
- ═ Project Area Boundary
- — U.S. Highway
- — Primary Road
- — Secondary Road
- — Closed USFS Road
- ------ Trail
- -·-·- River/Stream

Surface Ownership/Mineral Ownership

- ☐ Federal/Federal
- ▨ Federal/Private
- ☐ Private/Private
- ☐ Private/Federal
- ☐ State/State
- ▨ Fruitland Outcrop

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database

NORTHERN SAN JUAN BASIN CBM EIS

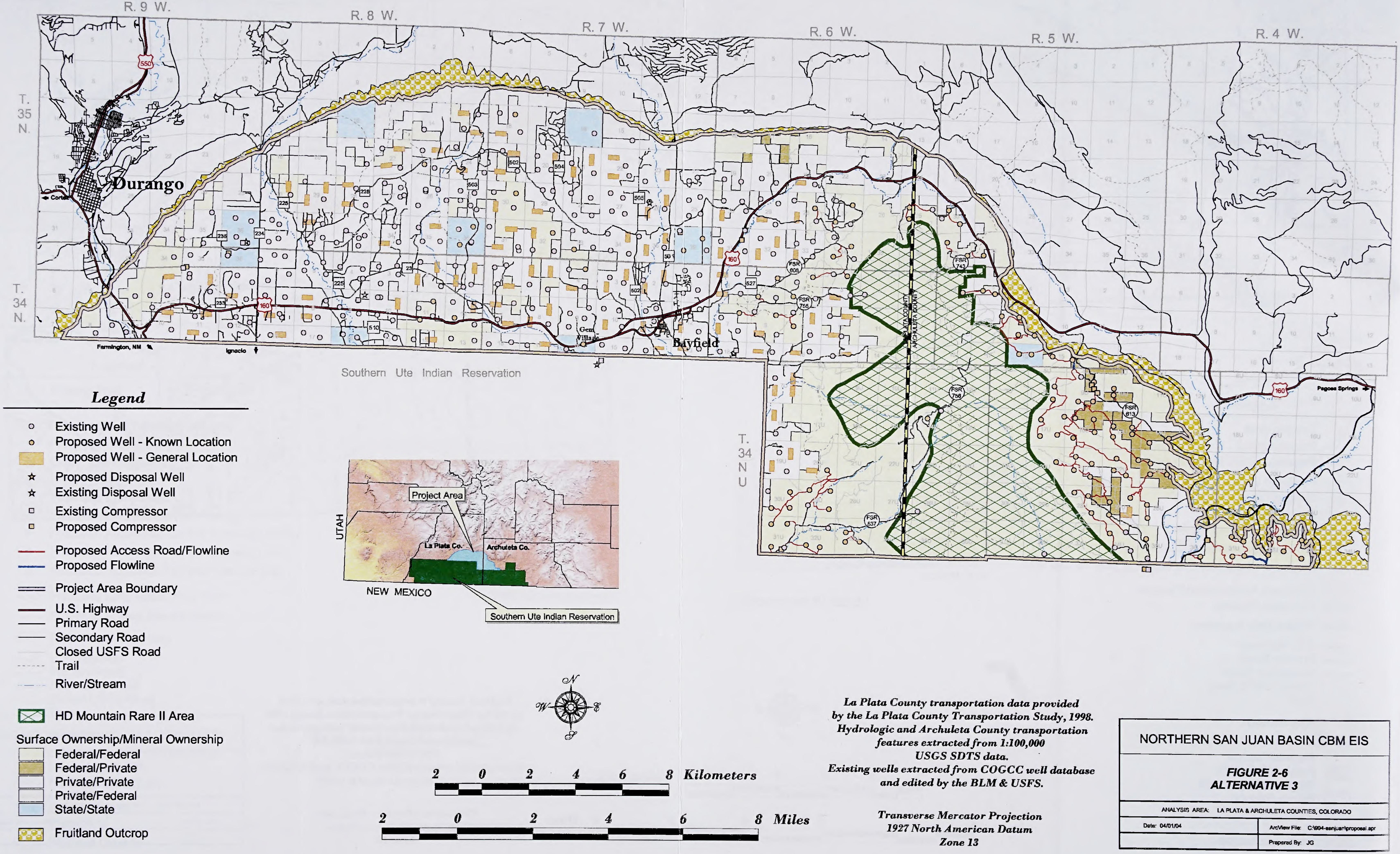
**FIGURE 2-7**
**ALTERNATIVE 4**

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

Date: 04/01/04

ArcView File: C:\994-sanjuan\proposal.apr

Prepared By: JG



*La Plata County transportation data provided by the La Plata County Transportation Study, 1998. Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data. Existing wells extracted from COGCC well database and edited by the BLM & USFS.*

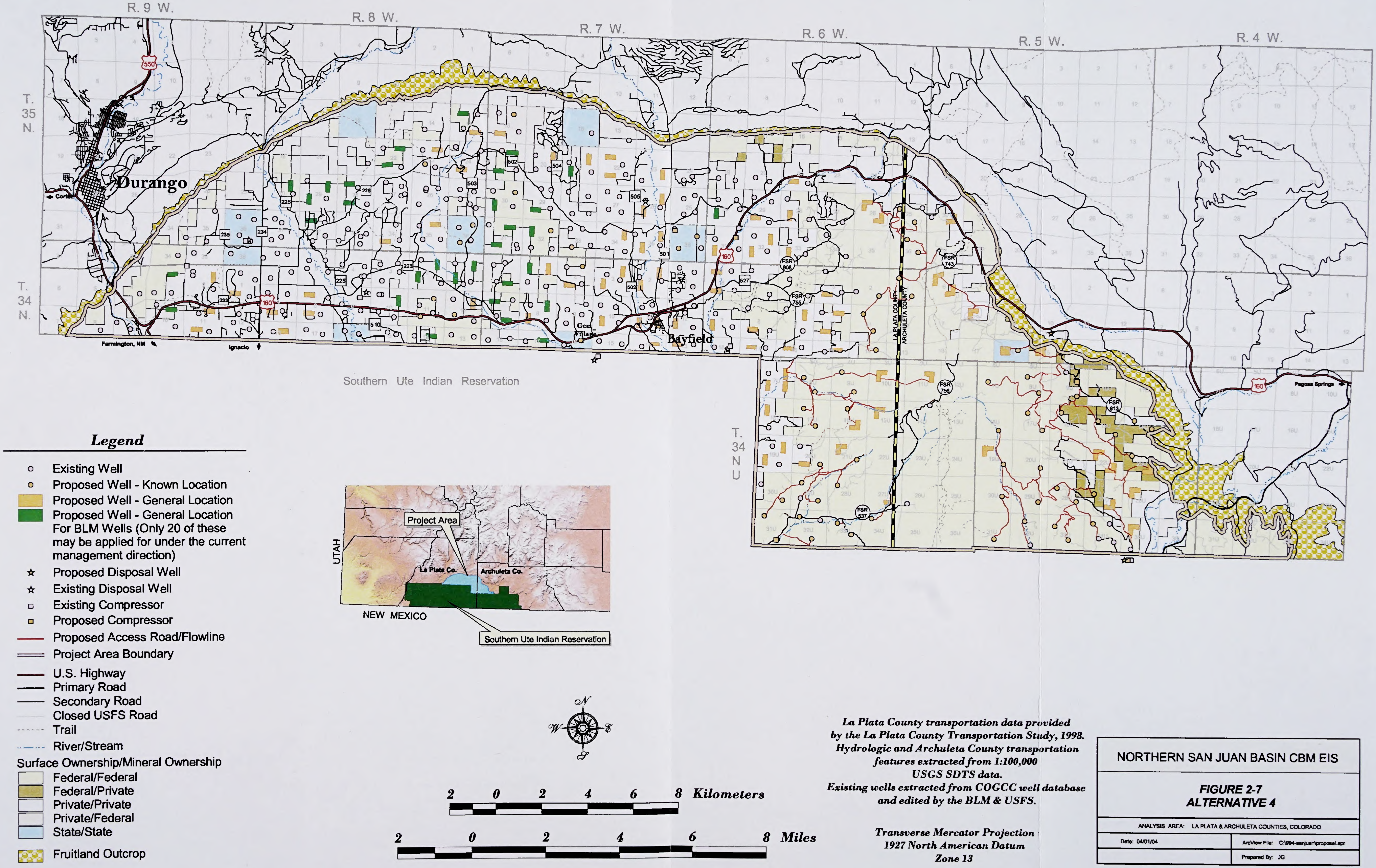
*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

NORTHERN SAN JUAN BASIN CBM EIS

**FIGURE 2-6**
**ALTERNATIVE 3**

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

Date: 04/01/04
ArcView File: C:\904-sanjuan\proposal.apr
Prepared By: JG



## Legend

- ○ Existing Well
- ○ Proposed Well - Known Location
- 🟨 Proposed Well - General Location
- 🟩 Proposed Well - General Location For BLM Wells (Only 20 of these may be applied for under the current management direction)
- ★ Proposed Disposal Well
- ☆ Existing Disposal Well
- □ Existing Compressor
- □ Proposed Compressor
- Proposed Access Road/Flowline
- Project Area Boundary
- U.S. Highway
- Primary Road
- Secondary Road
- Closed USFS Road
- Trail
- River/Stream

Surface Ownership/Mineral Ownership

- Federal/Federal
- Federal/Private
- Private/Private
- Private/Federal
- State/State
- ▨ Fruitland Outcrop

*La Plata County transportation data provided by the La Plata County Transportation Study, 1998. Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data. Existing wells extracted from COGCC well database and edited by the BLM & USFS.*

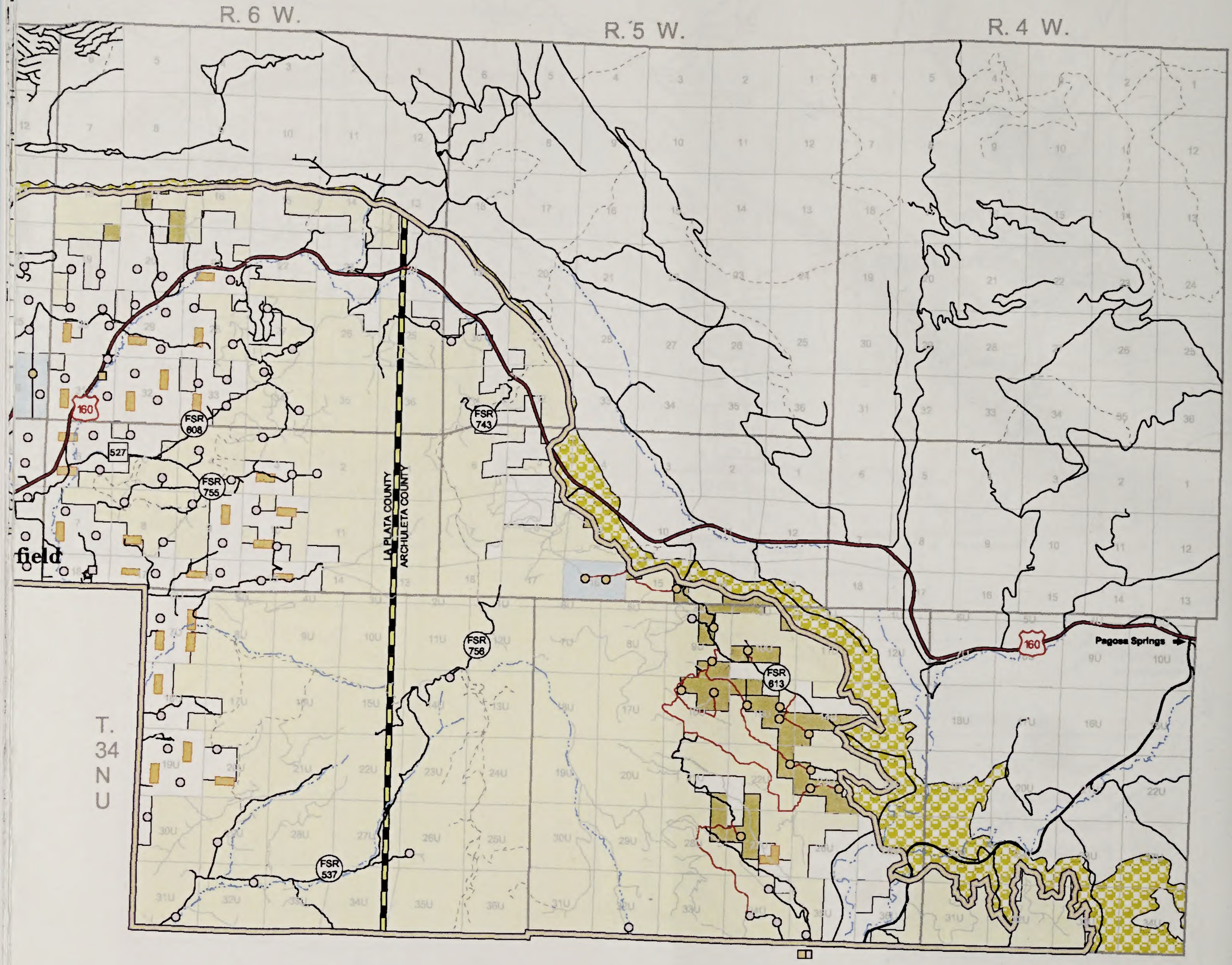
*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

NORTHERN SAN JUAN BASIN CBM EIS

***FIGURE 2-7***
***ALTERNATIVE 4***

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

Date: 04/01/04
ArcView File: C:\994-sanjuan\proposal.apr
Prepared By: JG



Kilometers

6 8 Miles

*La Plata County transportation data provided by the La Plata County Transportation Study, 1998. Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data. Existing wells extracted from COGCC well database and edited by the BLM & USFS.*

*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

NORTHERN SAN JUAN BASIN CBM EIS

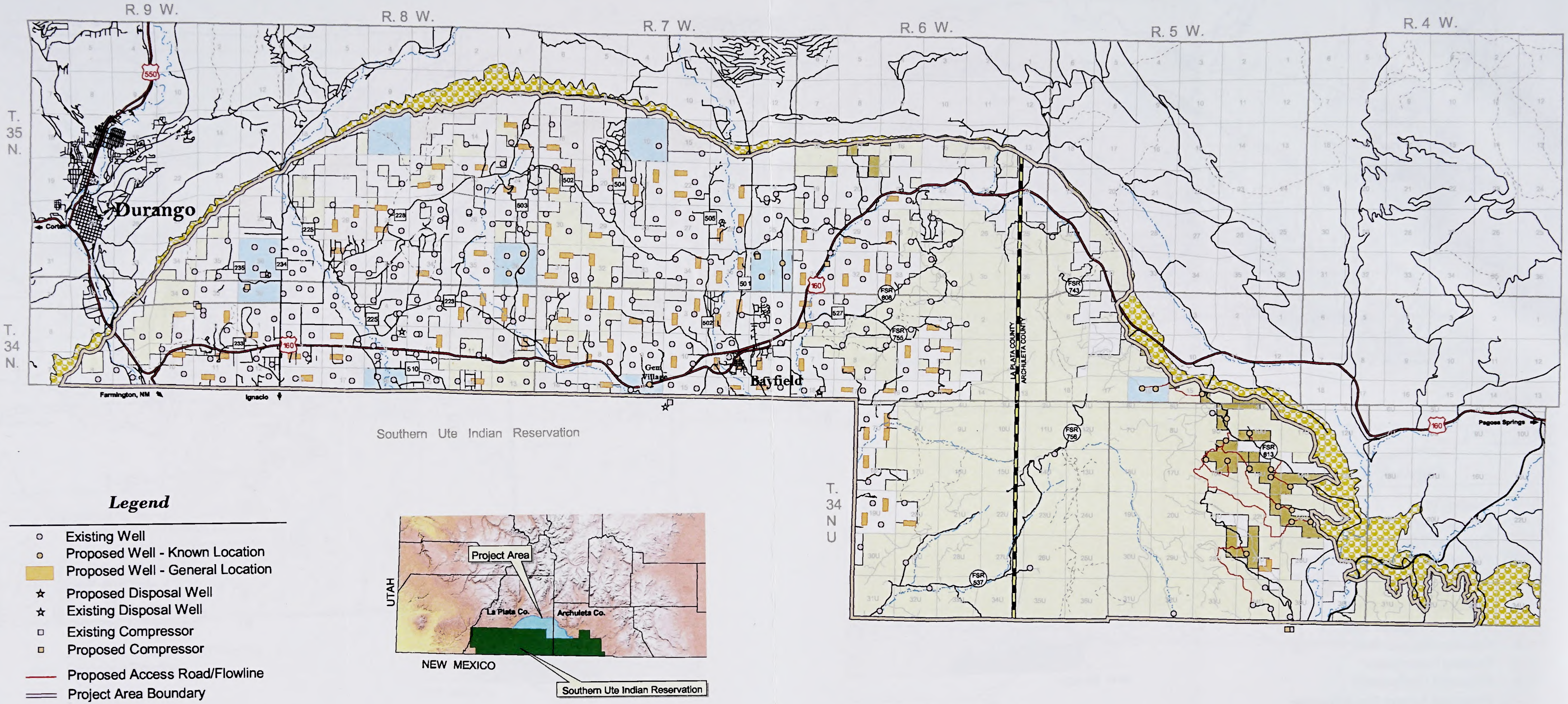
**FIGURE 2-8**
**ALTERNATIVE 5 NO ACTION**

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

| | |
|---|---|
| Date: 04/01/04 | ArcView File: C:\994-sanjuan\proposal.apr |
| | Prepared By: JG |

# Chapter 3

# Affected Environment and Environmental Consequences



## Legend

- ○ Existing Well
- ● Proposed Well - Known Location
- ▬ Proposed Well - General Location
- ☆ Proposed Disposal Well
- ☆ Existing Disposal Well
- □ Existing Compressor
- ■ Proposed Compressor
- ── Proposed Access Road/Flowline
- ══ Project Area Boundary
- ━━ U.S. Highway
- ── Primary Road
- ── Secondary Road
- ── Closed USFS Road
- ---- Trail
- -·-· River/Stream

Surface Ownership/Mineral Ownership

- ▭ Federal/Federal
- ▬ Federal/Private
- ▭ Private/Private
- ▭ Private/Federal
- ▭ State/State
- ▨ Fruitland Outcrop

2 0 2 4 6 8 Kilometers

2 0 2 4 6 8 Miles

*La Plata County transportation data provided by the La Plata County Transportation Study, 1998. Hydrologic and Archuleta County transportation features extracted from 1:100,000 USGS SDTS data. Existing wells extracted from COGCC well database and edited by the BLM & USFS.*

*Transverse Mercator Projection*
*1927 North American Datum*
*Zone 13*

NORTHERN SAN JUAN BASIN CBM EIS

**FIGURE 2-8**
**ALTERNATIVE 5 NO ACTION**

ANALYSIS AREA: LA PLATA & ARCHULETA COUNTIES, COLORADO

Date: 04/01/04

ArcView File: C:\994-sanjuan\proposal.apr

Prepared By: JG

# Chapter 3

# Affected Environment and Environmental Consequences

# Chapter 3 — Affected Environment and Environmental Consequences

This chapter describes the affected environment and environmental consequences for the alternatives evaluated in detail. The environmental analysis focuses on issues identified through the scoping process.

The affected environment, which is the portion of the existing environment that could be affected by the project, varies for each resource and issue. Both the nature of the issues and the components of the proposed action and alternatives dictate this variation.

An "environmental effect" or "consequence" is defined as "a modification of or change in the existing environment brought about by the action taken." Effects are direct, indirect, or cumulative and may be temporary (short term) or permanent (long term). Effects can vary in degree, ranging from only a slightly discernible change to a drastic alteration in the environment. This analysis considers short-term effects to be any that would occur during the Project's construction and drilling phases. Long-term effects are residual effects that persist during the production phase of the Project.

The analysis evaluates environmental consequences that would occur in the Project Area regardless of land ownership. Non-federal land impacts are evaluated to fully disclose overall effects of CBM development to the human environment and to support the environmental permitting of other agencies that have jurisdiction within the project area. The BLM and FS project decisions apply to federal jurisdiction only.

Each resource section in this chapter addresses:

- Resource specific issues
- Affected environment.
- Environmental consequences (direct and indirect effects).
- Cumulative effects.
- Monitoring and mitigation.
- Unavoidable adverse effects.
- Irreversible and irretrievable commitments of resources.

Direct effects are those caused by the action and that occur at the same time and place. Indirect effects are those caused by the action and are later in time or further removed in distance, but are reasonably foreseeable.

Cumulative effects are the impacts to the environment that result from the incremental impact of the action (CBM development) when added to other past, present and reasonably foreseeable future actions (RFFAs) regardless of what agency (Federal or non-Federal) or person undertakes such other actions. RFFAs include activities, developments, or events that have the potential to change the physical, social, economic, and/or biological nature of a specified area. Existing activities, projected activities directly associated with a proposed action, and other RFFAs provide the basis for defining and analyzing future cumulative impacts.

Mitigation is the action the agency would take to either avoid an impact altogether, or to reduce an impact, rectify an impact, or compensate for an impact by replacing or providing substitute resources or environments.

Unavoidable adverse effects are impacts that cannot be avoided through the application of alternatives and mitigation should the proposal be implemented.

An irreversible commitment of resources refer to primarily to the effects of use of non-renewable resources such as minerals or cultural resources, or to those factors such as soil productivity that that are renewable only over long periods of time. An irretrievable commitment applies to the loss of production. For example, all or part of a well pad is lost to prior uses as the pad serves CBM gas development for an extended period.

CBM development is the action that prompts direct and indirect effects in this EIS. Conversely, numerous associated actions contribute to cumulative effects. The following reasonable foreseeable future actions work synergistically to produce the cumulative impacts analyzed in this EIS.

# 3.1 Actions Contributing To Cumulative Effects

## 3.1.1 Cumulative Effects Analysis Area

The general cumulative effect analysis area for most resource analyses is the Project Area (125,000 acres) and that portion of the Southern Ute Indian Reservation that has and will continue to experience CBM development over the next decade (422,000 acres). The cumulative effects analysis area is therefore 547,000 acres, encompassing the Colorado portion of the SJB. The water, economic, and air quality cumulative effects analysis area, however, extends into New Mexico and includes foreseeable oil and gas development within the BLM Farmington Resource Area and Jicarilla Ranger District, Carson National Forest.

The cumulative effect analysis considers the environmental consequences of oil and gas development. Other activities that have and may contribute to cumulative impacts include rural and urban housing development, timber harvest, fire management, livestock grazing, recreation, agriculture, and road construction.

### 3.1.2 Oil and Gas Development

Oil and gas development is projected to continue both within and south of the Project Area. The Proposed Action involves drilling of 296 additional CBM wells over the next decade within the Project Area, as described in Chapter 2. South of the Project Area, within the bounds of the Southern Ute Reservation, 636 additional gas wells, 70 injection wells for enhanced coal bed methane projects, and associated facilities are projected for Tribal minerals and 586 wells are projected for non-tribal minerals. Other reasonably foreseeable oil and gas development includes development in the New Mexico portion of the SJB (CBM, conventional gas, and oil). Within New Mexico, the FEIS for the Farmington Resource Area RMP projects development of 9,900 new wells over the next 20 years, drilled at a rate of about 500 wells per year. This level of regional development is important when assessing economic, water, and air quality impacts. The cumulative effects area for most other resources is more localized due to a lack of interaction of resources between the two regions defined by northern New Mexico and Southwest Colorado.

The SJB is already substantially developed for oil and gas production. Today there are more than 26,000 wells in the SJB operated by dozens of operators. Within the Colorado portion of the SJB, there are approximately 2,500 wells in operation. Where the productive trends in different geologic formations overlap or where oil is produced in New Mexico, there are often more than a dozen wells in a single 640-acre section. In less prospective areas, there are only one or two producing wells in a section.

This level of development presented above when taken with existing development, presents concerns about degradation of wildlife habitat effectiveness, impacts to the area's visual quality, the potential for reduced property values, impacts to recreational settings and opportunities, noise conflicts, depletions of surface waters, and various health and safety issues, particularly at the Fruitland Formation outcrop.

### 3.1.3 Community Expansion

Community expansion has and will continue to contribute to cumulative impacts. Community Expansion in La Plata County is expected to include growth in the residential population, related increases in commercial operations and development of county roads, and small industrial developments unrelated to mineral resources. No major industrial project, such as a power plant or new factory, is foreseen in La Plata County. Instead, community growth is expected to be based on influx of individuals, families, and retirees attracted to the Four Corners area life style. The economy of the cumulative effects area and other nearby counties is predicted to expand but to stay distributed over the same industries that comprise it now. Population will continue to be concentrated in the communities of Durango, Bayfield, and Ignacio, but residential development will also continue to encroach on agricultural and forested lands and on oil and gas production facilities, especially in the central and northern parts of the La Plata County. Gas development is already spread throughout the area where the San Juan Basin overlaps the County. Residential development in those areas will in many places coexist with gas well development.

Southwestern Colorado is generally growing faster than most areas of the country. According to the Florida Mesa and Bayfield District Land Use Plans, population growth rates of over 3-percent per year were recorded during 1992 to 1996 (La Plata County Planning Department 1997, 1998). Neither La Plata nor Archuleta Counties have any burgeoning industry, which would cause people to move there for job opportunities. In fact, the opposite appears to be true: people move to the area despite poor job prospects because they value the non-urban lifestyle and recreational opportunities of the Four Corners area. Some new residents are independent of the local economy, for example retirees, telecommuters. The populations of La Plata and Archuleta Counties, particularly within the rural areas, will continue to grow as long as the current community attributes are maintained.

The gas industry along with other base industries contributes cumulatively to local jobs, income and the local county revenues. Tourism will continue to be a vibrant and visible piece of the economy (hotels and motels, restaurants, Purgatory ski area, resorts, gift shops, and other recreational services). The SUIT will remain one of the largest single employers in the area, continuing to fund it primarily with current energy revenues and earnings on invested revenues. Approximately half of the Tribe's employees work at the Tribe's Sky Ute Casino, which funds itself and funnels earnings back to the Tribe. Fort Lewis College, the public school districts, and the Mercy Medical Center are also predicted to remain large employers in the area, growing in service to the area's growing population. The oil and gas industry will decline in the future with depletion of reserves and the associated decline of operations and investments.

The increase in broadly spaced, rural residential development in La Plata and Archuleta Counties is recognized as a problem on several counts. First, it reduces wildlife habitat. Second, it increases the cost of providing basic services, to residents such as roads and bridges, water, sewage control, electricity, and natural gas. Third, it degrades scenic views. "Current subdivision practices are developing the counties into smaller and smaller lots, gradually eroding the very qualities that attracted most residents." Finally, it has increased in the potential for conflict between residents and gas industry development. La Plata County government is promoting the development of district plans, which include substantial input from the district residents, and both the State and La Plata County have regulated the oil and gas industry to address residential development issues.

Community expansion will impact biological resources by changing land use and destroying habitat. Houses and new roads take away grazing and forage areas. Roads threaten migration routes, and animals of all types are often killed while attempting to cross roads. Human activity disturbs wildlife, can stress and weaken individual animals, and lowers reproduction rates. Community Expansion will add noise, affect visual resources, decrease water quality and/or quantity, and add traffic. It may impact soils by replacing agriculture with subdivisions. It should not impact geologic resources except by encouraging the development of gravel resources. It should be an overall positive socio-economic impact because of increased and maintained job opportunities, diversification of the employment base, and increased tax revenues to various taxing entities that in turn provide services to residents.

### 3.1.4 Timber Harvest and Fire

The effects of timber harvest and fire suppression are of concern in the SJNF portion of the cumulative effects area. Timber harvest when taken with other vegetation or ground disturbing activities such as oil and gas development would cumulatively impact soils, water quality, recreation, and particularly wildlife and their habitats. Records of past timber harvest activity indicate that between 1941 and 1996, 6,870 acres of ponderosa pine and mixed conifer were harvested in the Project Area on NFS lands. Approximately 1,535 acres of ponderosa pine and Douglas-fir were converted by harvests to different vegetation types including grasslands (103 acres); mountain shrub (55 acres); sagebrush (237 acres); Gambel oak (895 acres); pinyon-juniper (214 acres); riparian (5 acres); and barren (26 acres). These treatments benefited early successional wildlife species to the detriment of those that thrive on older forested ecosystems. There are also periodic timber harvests and thinning of small tracts of private and Reservation lands that contribute to perpetuating younger age classes of ponderosa pine, as has been the case over most of the SJNF.

A current SJNF timber sale straddles the northeastern border of the Project Area. Cutting activities are planned for the summer of 2003. The timber sale will commercially thin 157 acres of ponderosa pine. After harvest, a 500-acre prescribed burn is planned to reduce fuels and enhance pine regeneration. There are three additional vegetation treatment projects that are in various stages of planning: The FS is reviewing ponderosa pine fuels reduction treatments in the Fosset Gulch, Saul's Creek, and Lange Canyon areas. None of these activities is expected to individually or cumulatively affect wildlife detrimentally, but are designed to maintain the health and resilience of forested ecosystems. This is important when factoring the effects of impacting activities.

Fire suppression has been the overriding strategy for dealing with all fires in the Project Area since settlement in the late 1800s. This strategy has caused a somewhat unnatural mix of vegetation in terms of structure and density. There are many more small-diameter trees and shrubs present today than there would be had fire played a role in the last 100 years. This limits the moisture and sunlight available for grasses and forbs to grow. Fire exclusion results in fewer, larger stems of Gambel oak, for example. The changes in vegetation cover resulting from fire suppression are important when evaluating the cumulative impacts of management prerogatives and projects on wildlife.

Somewhat offsetting fire suppressions effects are prescribed fires conducted in the HD's over the past 16 years that treated close to 10,500 acres. The primary effect to vegetation from these burns was to top-kill Gambel oak. No significant changes in tree canopy closure or density occurred because of these burns, and consequently there was impact to wildlife species from these projects.

## 3.1.5 Livestock Grazing

The BLM and NFS lands in the Project Area are generally available as rangeland for livestock under permitted grazing allotments. A grazing allotment is an area of land designated and managed for the grazing of livestock by one or more livestock operators. The number of livestock (stocking rate or carrying capacity) and period of use are stipulated for each allotment. The carrying capacity is an estimate of the maximum number of animals (expressed in Animal Unit Months [AUMs]) a given area can support each year without damage to vegetation or related resources. One AUM is the amount of forage necessary to support one animal-unit for one month. An animal-unit is a 1,000-pound cow typically consuming 780 pounds of air-dry forage for one month.

Grazing allotments are managed and multiple land uses are coordinated to maintain healthy public lands. The San Juan/San Miguel Planning Area RMP and amended RMP (BLM 1985, 1991), and the Decision Record for the Standards for Public Land Health and Guidelines for Livestock Grazing Management (BLM 1997) apply to development on BLM lands. The standards and guidelines for the NFS lands in the Project Area are provided in the SJNF LRMP and amended LRMP (FS 1982, 1992). These standards and guidelines are also discussed in the Vegetation section of this chapter.

The Project Area contains entire, or portions of, 7 BLM grazing allotments and 10 FS grazing allotments. Livestock grazing is permitted on 5 and 7 of the allotments, respectively. On BLM lands, 300 AUMs are permitted for livestock grazing and on NFS Lands, 2,899 AUMs are permitted. Grazing is permitted on approximately 68 percent of public lands within the Project Area. Due to the steep, rugged terrain, livestock can graze only about 35 percent of NFS lands within the Project Area. BLM lands are generally more accessible within the Project Area. Range monitoring shows an upward trend in terms of species composition and cover to the benefit of wildlife.

## 3.1.6 Recreation

A broad spectrum of recreation occurs year-round in the Project and cumulative effect area. Summer activities include hiking, mountain biking, hunting, fishing, camping, sightseeing, ATV riding, and wildlife viewing. Both BLM and SJNF are open seasonally to ATVs. CBM development's expansion of the road system, particularly on the SJNF, can attract additional motorized recreation use and could open up significantly more country. Areas easily accessible from Durango and Bayfield, such as Sauls Creek, are also expected to see increased day use for picnicking, hiking, mountain biking, and horseback riding because of increases in nearby populations. Increased human use of the project area over time can result in wildlife harassment and, in the extreme, to habitat displacement. There is no indication that that is occurring now, but restriction of motorized human access to the project area must be considered as an option to mitigate these wildlife concerns in the future.

Recreational development is predicted to conflict with oil and gas development in the cumulative effects area during the project period. Most recreational development in the Four Corners is likely to occur in the towns themselves (e.g., Durango Recreation Center, Bayfield Recreation District) or in mountainous public lands (e.g., trails, trailhead facilities) where CBM development is now proposed. Some recreational facilities may be developed in association with residential subdivisions (e.g., bike paths), but such development could be coordinated with oil and gas facilities. The Animas-La Plata project could include a large recreation development (reservoir) but would be outside of the current oil and gas development area. No expansion of the Lake Navajo Recreation Area is foreseen.

Cumulative effects from other activities on private lands, such as ranching and agriculture cannot be quantified because of a lack of formal study, but are discussed qualitatively in this chapter.

**Table 3–1 Categories of Actions included in Cumulative Effects Analysis**

| General Category of Activity | Amount | Year | Resource of Concern |
|---|---|---|---|
| Past and Present Actions | | | |
| Oil and Gas Development | Acres or miles of disturbance | Year or period in which activity occurred | All |
| Community Expansion | | | Wildlife, land use, recreation, transportation, social and economic values |
| Timber Harvest and Fire | | | Wildlife, water, soils, vegetation |
| Livestock Grazing | | | Wildlife, water, soils, vegetation |
| Recreation | | | Wildlife, transportation |
| Reasonably Foreseeable Future Actions | | | |
| Oil and Gas Development | Acres or miles of disturbance | Year or period in which activity occurred | All |
| Community Expansion | | | Wildlife, land use, recreation, transportation, social and economic values |
| Timber Harvest and Fire | | | Wildlife, water, soils, vegetation |
| Livestock Grazing | | | Wildlife, water, soils, vegetation |
| Recreation | | | Wildlife, transportation |

# 3.2 Existing CBM and Non-CBM Development

The alternatives discussed in Chapter 2 result in environmental consequences that are in addition to those resulting from existing CBM and non-CBM development within the Project Area. To understand the cumulative impacts of CBM and other land-impacting activities that act in synergy, an accounting of existing impacts is important. The following is a summary of the existing impacts of various CBM and non-CBM activities as of the end of 2001.

## 3.2.1 Wells

As of the end of 2002, approximately 290 CBM wells and 13 non-CBM wells (conventional oil or gas) had been completed in the Project Area. Construction of the pads for the CBM wells has resulted in a total short-term conversion of 406 acres and a long-term conversion of 290 acres to well pads. Construction of the pads for the non-CBM wells has resulted in a total short-term disturbance of 34 acres and a long-term disturbance of 21 acres. About 79 percent of the surface disturbance from CBM wells has occurred on private land.

In addition to the CBM wells constructed through 2002, the agencies expected as many as 34 CBM wells to be constructed somewhere within the Project Area during 2003. The 2003 wells are considered part of existing CBM development, because these wells would be completed before the agencies release the ROD for this EIS. Although the locations of these wells were unknown at the time of this analysis, probably most would be drilled on private or state-owned land. The agencies assume that construction of these 34 wells would result in short-term disturbance of 48 acres and long-term disturbances of 34 acres.

### 3.2.2 Produced-Water Disposal Wells

Five water disposal wells are in the Project Area and one is immediately outside it. Construction of these wells has resulted in 10 acres of short-term disturbance and 8 acres of long-term disturbance in the Project Area, and 2 acres of short-term disturbance and 1.6 acres of long-term disturbance outside it.

Water produced from existing CBM wells is handled differently in the western and eastern halves of the Project Area. In the western half, the companies transport the produced water via pipeline directly to one of six disposal wells. BP America disposes of produced water in three wells: the Los Piños Disposal Well (NE ¼ of Section 31, T35N, R6W), the Wallace Gulch Disposal Well (SW ¼ of Section 26, T35N, R7W), and the Bayfield Disposal well (SE ¼ of Section 18, T34N, R6W). BP America also can route some produced water to other disposal wells south of the Project Area. J.M. Huber disposes of produced water in a disposal well at its DCS Central Facility. Pure Resource disposes of produced water at a disposal well in Section 36, T35N, R9W. In contrast to the western half of the Project Area, produced water from wells in the eastern portion of the Project Area is currently trucked to sites approved for disposal.

### 3.2.3 Compressor Stations

The companies use several compressor stations to compress CBM from wells for transport to delivery pipelines. These stations, which vary in size and number of compressors installed, are distributed across the Project Area in La Plata County.

There are four compressor stations in the Project Area; two are outside it. Construction of these stations has resulted in 12 acres of short- and long-term disturbance in the Project Area and 6 acres of short- and long-term disturbance just outside it. Table 3–2 summarizes the details of the companies' compressor stations.

### 3.2.4 Access Roads and Gas- and Produced Water-Gathering Pipelines

For this analysis, the agencies assume that the access roads and gas- and produced-water-gathering pipelines will be constructed together within the same corridor. Additionally, we assume that the long-term disturbance for the corridor for the access road and gathering pipelines is 25 feet wide and that the average length of the corridor for each access road and gathering pipeline is 1,074 feet, or

0.2 mile (Bell 2001). Consequently, the existing long-term disturbance associated with each access road and gathering pipeline is 0.6 acres, and the total long-term disturbance for all 289 CBM and non-CBM wells is 175 acres. The roads for the 34 CBM wells constructed in 2002 created almost 21 acres of long-term disturbance, but these roads are not identified on the EIS maps for this analysis.

**Table 3–2 Summary of the Companies' Existing Compressor Stations**

| Location | Name | Description | Total Horsepower |
|---|---|---|---|
| SW ¼ SE ¼ Section 36 T35N, R9W | State 36-2 Site | Two gas-fired units | 2,220 |
| NW ¼ NW ¼ Section 2 T34N, R9W | Crader Site | One gas-fired unit | 1,100 |
| NE ¼ NE ¼ Section 9, T34N, R8W | Durango Compressor Station (DCS) Facility | Six electric reciprocating units | 5,500 |
| NE ¼ Section 18 T34N, R6W | Bayfield Facility | Three electrically driven screw units | 11,000 |
| W ½ Section 15 T34N, R7W | Dry Creek[1] | Three lean-burn, gas-fired units | 11,000 |
| Section 3 UT33N, R5W | Pargin Mtn.[1] | | 1,100 |
| Total | | | 31,920 |

Note:
1. Slightly outside of the Project Area
Sources: Bell 2001 and Brown 2001

## 3.2.5 Summary of Existing Development

Existing development is summarized in Table 3–3; disturbances are incorporated into the cumulative effects.

**Table 3–3 Summary of Existing Oil and Gas Development**

| Facility | Number of Units | Amount of Disturbance (acres) | |
|---|---|---|---|
| | | Short Term | Long Term |
| Mapped Development | | | |
| CBM Wells | 276 | 386 | 276 |
| Non-CBM Wells | 13 | 34 | 21 |
| Disposal Wells | 5 | 10 | 8 |
| Compressor Stations | 4 | 12 | 12 |
| Roads (miles) | 57.8 | 173 | 173 |
| Total | | 615 | 490 |
| Unmapped Development[1] | | | |
| Wells[2] | 34 | 48 | 34 |
| Disposal Wells[3] | 1 | 2 | 2 |
| Compressor Stations[3] | 2 | 6 | 6 |
| Roads[4] (miles) | 6.8 | 20 | 20 |
| Total | | 76 | 62 |
| Total | | 691 | 552 |

Notes:
1. Includes facilities immediately outside the Project Area.
2. Assumed number of wells drilled in 2002.
3. Located immediately outside the Project Area.
4. Information was not mapped.

## 3.3 Migration and Seepage of Methane

Methane seepage can be divided into two areas of concern:

- The Fruitland outcrop, and
- The interior of the basin.

The two regions are shown on Figure 3–1.

### 3.3.1 Methane Seepage at the Outcrop

Specific concerns related to methane seepage at the outcrop of the Fruitland Formation include:

- Increase in dead trees and plants,
- Risk to human health and safety,
- Loss of natural gas resource,
- Reduction of wildlife habitat, and
- Contamination of domestic water wells tapped into the Fruitland Formation.

Though it was reported historically, this methane seepage has accelerated with the beginning of CBM development. It remains confined to the outcrop of the Fruitland Formation (Figure 3–1).

(Note: naturally occurring gas seeps have been observed from Menefee coals west of Durango, in the Lewis Shale in Ridges Basin, and in the Lewis Shale at Yellowjacket Pass in Archuleta County. None of these seeps is reported to be increasing in rate or areal extent. Only the seeps on the outcrop of the Fruitland Formation appear to be affected by gas development in the San Juan Basin.)

### 3.3.2 Methane Seepage in the Basin Interior

Methane seepage in the interior of the San Juan Basin affects domestic water wells. This methane seepage is associated with older conventional gas wells (dating from the 1950s and 1960s) that were not cemented to the ground surface when they were installed, creating a conduit for migration of methane from the Fruitland Formation upward to the shallow aquifers (Figure 3–2).

The BLM and COGCC require operators to monitor the pressures in the surface or intermediate casing (Bradenhead pressures) annually in each gas well. This program was developed to identify potential problem wells that may be acting as conduits for methane from the reservoir formations into the shallow aquifers. Should excessive pressures be detected, the operators are required to repair the well. Repairs consist of forcing cement between the well casing and in the rock formations between the Fruitland Formation and the shallow aquifers to create a seal. This seal prevents the upward flow of methane. In addition, the COGCC and BLM therefore now require that the gas well casing (surface and production casing) be cemented from bottom to top.

Annual Bradenhead pressure measurements are recorded so that remedial actions can be taken on these older wells as soon as a potential problem is identified. Rapid response should prevent any potential contamination by methane in the shallow aquifers from spreading to any nearby domestic water wells.

There are other potential sources of methane in shallow aquifers that are not associated with CBM development. These are biogenic methane and microseepage from deep formations over geologic time scales. Biogenic methane is generated by bacteria called methanogens, which are present in many subsurface settings. Microseepage is simply a low flux of methane migrating upward from hydrocarbon reservoirs and source rocks. The low flux of methane is measurable over many known gas reservoirs, and microseepage may occur within the Project Area as a natural phenomenon.

Hydrofracturing and cavitation do not create pathways for migration of methane from the coal beds in the Fruitland Formation to the shallow aquifers. Fracture-stimulation effects extend up to 600 feet laterally from a well bore, and vertical propagation of fractures is typically confined to the coal beds (Diamond 1987). More than 2,000 feet of strata intervenes between the Fruitland coal beds and the shallow domestic aquifers in the interior of the basin. As a result, fractures will not propagate from coal beds to the shallow aquifers, even under the most extreme fracturing pressures used in CBM development. Effects from cavitation are even more limited in the subsurface, typically affecting only the coal beds to a distance of less than 100 feet (EPA 2002a).

In summary, there have been no documented cases where CBM development (either well drilling, fracing, or operations) could be linked to methane in shallow aquifers. There are, however, two natural phenomena that more likely explain the occurrence of methane in shallow aquifers. These are biogenic-sourced methane from bacteria, and microseepage that occurs naturally over geologic time.

Because there is no plausible evidence that CBM development would impact shallow aquifers in the basin interior through methane seepage, this issue will not be carried forward in the remaining analyses of environmental impacts.

### 3.3.3 Scoping Issues

Public concerns raised during the scoping process for the EIS are:

*Issue 1: What are the effects of additional CBM development on groundwater aquifers and wells, with respect to methane seepage and contamination?*

The following are specific facets of this issue:

- Will dewatering the Fruitland Formation trigger the release of methane and hydrogen sulfide in unpredictable ways, especially near the outcrop?
- What are the effects at the outcrop of continued or accelerated dewatering of the Fruitland Formation?

- Will intensified drilling affect shallow aquifers within the basin interior?

- How will CBM-related seepage affect surface water resources? Will increased CBM development increase seepage-related impacts on surface water?

- How will CBM-related seepage affect human health and safety? Will increased CBM development increase the risks to human health and safety?

- What are the effects of CBM-related seepage on vegetation and wildlife? Will increased CBM development increase the impacts on vegetation and wildlife?

- Does methane seepage affect soils in the project area? Will increased CBM-related seepage affect soils in the project area?

## 3.3.4 Background

Since the late 1800s, methane seeps have been observed and reported in the SJB, particularly from the outcrop of the coal beds in the Fruitland Formation. The number of reports and complaints of methane seeps received by public officials increased from the mid-1980s into the 2000s (BLM et al. 2002). This increase coincided with intensified development of CBM in the coal beds of the Fruitland Formation and a concurrent increase in population in the Project Area. Data suggest that the intensity and areal extent of known seeps increased and that new seeps developed after CBM development began (BLM et al. 2002). Consequently, it has been shown that depressurization of the coals in the Fruitland Formation by CBM wells installed near the outcrop caused new and expanded existing seeps. It is estimated that CBM development within 4 to 6 miles of the outcrop has caused the methane seeps to expand.

### 3.3.4.1 Methane ($CH_4$)

Methane is a gas that is created naturally from decomposition of organic compounds, including coal. Methane is a nontoxic, nonpoisonous gas that does not cause cancer. Its presence can pose a risk to human health and safety, however (such as hazards from explosion and confined-space entry), and seepage at the ground surface can adversely affect other natural resources, including vegetation and wildlife.

Methane is highly flammable and explosive under certain conditions. Methane that seeps into confined spaces that are poorly ventilated or unventilated (basements or water wells, for example) and are exposed to a source of heat can explode or burn. The buildup of methane in inadequately ventilated, confined spaces that people may occupy poses a risk of suffocation (methane displaces oxygen, creating an oxygen-deficient atmosphere in a confined space).

In addition to being flammable and explosive, methane displaces oxygen from pore spaces within soils. This displacement deprives plant roots of the oxygen they need for respiration, ultimately killing the plant. The presence of dead vegetation around gas seeps in pastures and stands of stressed and dying trees on the coal beds are indications of active methane seeps.

### 3.3.4.2 Hydrogen Sulfide ($H_2S$)

Hydrogen sulfide is also associated with some of the methane seeps. The methane can create an anaerobic environment where sulfate-reducing bacteria proliferate. These bacteria release hydrogen sulfide, a colorless, foul-smelling, toxic gas. This gas can damage vegetation by impairing the plant's respiratory function. In addition, hydrogen sulfide is harmful to the health of wildlife and humans when it is present in sufficient quantities.

In the Project Area, hydrogen sulfide occurs near the Carbon Junction methane seeps in the Animas River Valley and at one known site along Texas Creek, on CR 502.

Hydrogen sulfide has been reported since the late 1800s at the Animas River Valley seep; therefore, it is not associated with CBM development. The hydrogen sulfide at Texas Creek may or may not be associated with CBM development. The BLM's outcrop monitoring indicates that concentrations of hydrogen sulfide in the Project Area are not increasing. Monitoring will continue because of the public-safety issues associated with hydrogen sulfide, and because marked increases have been observed along the outcrop of the Fruitland Formation southwest of the Project Area.

## 3.3.5 Current Conditions—Methane Seepage

As discussed above, methane migrates and seeps naturally and because of human activities in the Project Area. Known naturally occurring methane seeps include Carbon Junction where the Animas River crosses the Fruitland Formation, the Pine River/Texas Creek/Florida River area, and Ridges Basin (Figure 3–3). Other seeps that are not associated with the Fruitland Formation have also been observed in La Plata and Archuleta Counties. Specifically, BLM personnel have observed seeps in the Menefee Formation near Ridges Basin in La Plata County and in the Lewis Shale near Yellowjacket Pass, off Highway 160 in Archuleta County. The Bureau of Reclamation (BOR) also identified and mapped gas seeps from the Lewis Shale in the Ridges Basin area.

The BLM has been monitoring methane seepage along the outcrop of the Fruitland Formation six times per year (every other month) since 1994. BLM analysis of the monitoring data in 2000 indicated that concentrations of methane are increasing in the shallow soils that immediately overlie the coal beds of the Fruitland Formation in some areas. The results also indicate that not all the coal beds seep methane, and that no active seeps have been identified over the strata in the Fruitland Formation that are not composed of coal (such as sandstones and mudstones). Field monitoring of seeps also indicates that the intensity of the seep may be decreasing in some areas, yet the area affected by methane seepage is expanding. In other words, the flow rate decreases at a specific location, but the area where flow occurs increases.

Methane seeps along the outcrop are best described as spotty. Intense seeps, where vegetation dies off, usually occur in areas of less than ¼ acre, but intense seeps that cover several acres have been documented in several locations, such as Carbon Junction. There is not a continuous belt of dead vegetation along the outcrop of the Fruitland Formation.

Lower-intensity seeps along the outcrop do not cause vegetation die-offs. The rate of methane seepage at these locations is too low to displace air in the overlying soils to the point where plant roots are deprived of adequate oxygen. The BLM's monitoring program has identified these types of seeps at areas east of the Pine River, Edgemont Ranch, Ridges Basin, and Texas Creek (Figure 3–4). Low-intensity seeps also occur randomly along the outcrop and appear to occur only where a coal bed immediately underlies the seep area.

In 1999, the BLM, the Southern Ute Indian Tribe (SUIT), and COGCC contracted with Questa Engineering, Applied Hydrology Associates, and the Colorado Geological Survey (CGS) to conduct the 3M (Modeling, Monitoring, and Mapping) Study.

The modeling by Applied Hydrology Associates and Questa Engineering concluded that methane seepage at the outcrop of the Fruitland Formation has increased since CBM development began (Figure 3–5 and Figure 3–6). The 3M model predicted that the intensity of the seep, or methane flux, would decline in some areas of pre-existing seeps, but that the overall area affected by methane seepage would increase (Figure 3–7 and Figure 3–8). This conclusion is supported by the BLM's monitoring data.

Current conditions were quantified, with total methane seepage rates of approximately 6 million cubic feet per day (MMcfd) across the Project Area. These current conditions served as the basis for comparing rates of methane seepage that result from various development scenarios.

The model predicts that gas seepage has occurred and will continue to occur at the current seeps (Questa 2000). As of early 2000, methane seepage in the SJB increased by at least 3 MMcfd, and possibly by as much as 10 MMcfd, over predevelopment levels (Questa 2000). The model also predicts increases in the rate of methane seepage along the outcrop and in the areal extent of methane seeps, regardless of the development scenario. Changes in the seepage rates and areal extent of methane seeps vary subtly among development scenarios, however. In other words, the natural system affected by CBM development is not especially sensitive to the number or density of wells, extraction rates, or other variables. There is, for example, little difference in seepage rates and occurrence of seeps between 160-acre well spacing and 320-acre well spacing. Furthermore, seep occurrence and rates do not appear to be sensitive to the timing of and well spacing for wells drilled within 1.5 miles of the outcrop of the Fruitland Formation.

Up to 20 domestic wells draw water from the Fruitland Formation and Pictured Cliffs Sandstone along the outcrop belt in the Project Area (Figure 3–9). These wells are open to the coal beds and sandstones, and several are known to contain methane concentrations at saturated levels (13 milligrams per liter [mg/L]). The vigorous bubbling of methane can be heard at the wellhead in one domestic well along Texas Creek. The water treatment system vents to the atmosphere, however, and poses no risks to human health and safety.

Areas of dead vegetation have been mapped, and it appears that the extent of methane seeps has not increased significantly over the past 2 years. Most of the vegetation die-offs occurred during the initial 10 years of CBM development in the NSJB, and the increase in affected area appears to have slowed markedly. Currently, it is estimated that less than 300 acres of vegetation are affected along the outcrop of the Fruitland Formation. This estimate is based on field surveys of the outcrop area.

A semi-quantitative approach was used to estimate the maximum potentially affected area. Using an average outcrop width (¼ mile) times the length (40 miles) yields the total surface area of the outcrop of the Fruitland Formation in the Project Area. Coal beds make up about 20 percent of the Fruitland Formation, and methane seeps are confined to coal beds. Roughly 50 percent of the coal beds are seeping methane at several transects with active seeps. The total potentially affected area is calculated as width (¼ mile) times length (40 miles) times 0.20 (20 percent) times 0.50 (50 percent). Therefore, an upper limit of the total affected surface area can be calculated. This method yields 640 acres of affected vegetation as a maximum impact in the Project Area. This estimate does not imply that 640 acres have been affected, however. Rather, it is a reasonable estimate of the maximum area that ultimately may be affected by CBM development.

Rivers and creeks that flow across the Fruitland Formation also exhibit active methane seeps. Active seeps appear in Texas Creek, the Animas River, the Florida River, and the Pine River where they cross the Fruitland Formation. These seeps were reported before any CBM development began, and modeling results indicate that they will not increase in rate. (The areal extent of these seeps is likely to increase, but this will not affect the surface water, as the seeps that directly underlie the river channels will maintain a consistent rate of methane flow because of the consistent hydraulic head at the rivers.) Methane entrained in surface water volatilizes quickly into the atmosphere, where ultraviolet radiation ultimately breaks down its molecules. In fact, methane concentrations are too low to be measured within several hundred meters downstream of the active seep areas. Methane seepage into surface water has no measurable effect on water quality or aquatic life.

There is only one known occurrence of hydrogen sulfide seeps (Texas Creek) that may be associated with CBM development. The true timing and cause of the hydrogen sulfide at Texas Creek is unknown. However, a decrease in the water table in the outcrop coal beds in this area has been documented. This drop in the water table and the increase in methane seepage may have created the conditions for sulfate-reducing bacteria to bloom. Conversely, these bacteria may have been present historically, and the hydrogen sulfide was encountered only after a domestic well was drilled through this bacteria-filled zone.

On the Southern Ute Indian Reservation south of the Project Area, numerous vapor-monitoring tubes show increasing concentrations of hydrogen sulfide. The increasing trends are associated with CBM development. In light of the increases of hydrogen sulfide observed along the outcrop of the Fruitland Formation near the Project Area, it is considered likely that seeps of hydrogen sulfide will increase in the Project Area. Although the mechanisms for generation of hydrogen sulfide are understood, the extent and rate of the seeps cannot be quantified.

## 3.3.6 Affected Resources and Environmental Consequences — Methane Seepage

### 3.3.6.1 Groundwater

Groundwater resources along the Fruitland outcrop are affected by CBM development and would continue to be affected beyond the life of the project. With CBM development expanding eastward into Archuleta County, groundwater resources on the outcrop of the Fruitland Formation in Archuleta County would be affected by increased methane seepage.

#### *3.3.6.1.1 Alternative 1—Proposed Action*

The companies' proposed expansion of CBM development would increase the areas of the Fruitland outcrop that are affected by active methane seepage. Consequently, the number of shallow domestic wells, seeps, and springs that are affected by methane seepage also would increase.

According to the state water engineer's database, 20 water wells are situated on the outcrop of the Fruitland Formation (Figure 3–9). Any number of these wells may be affected with increased concentrations of methane.

#### *3.3.6.1.2 Alternative 1A*

The expansion of CBM development under this alternative would increase the areas of the Fruitland outcrop that are affected by active methane seepage. Thus, the number of shallow domestic wells, seeps, and springs affected by methane seepage would increase. Any number of the 20 water wells on the outcrop of the Fruitland Formation may be affected by increased concentrations of methane.

#### *3.3.6.1.3 Alternative 1B*

This alternative would have impacts similar to those described for Alternatives 1 and 1A.

#### *3.3.6.1.4 Alternative 2*

The results of the 3M study indicate that methane seepage at the outcrop is independent of 320-acre spacing versus 160-acre spacing, timing of development near the outcrop, or other factors. Therefore, maximum development is expected to increase the number of shallow water wells affected by methane seepage, as in Alternative 1.

Up to 20 shallow water wells may be affected by increased methane seepage.

#### *3.3.6.1.5 Alternative 3*

The impacts of this alternative would be similar to Alternative 1. Development would not occur in a large portion of the basin interior under this alternative.

However, wells nearer the outcrop would be drilled and operated, thus inducing methane seepage at levels similar to those of Alternative 1. Approximately 20 domestic wells could be affected.

#### 3.3.6.1.6 Alternative 4

The impacts of this alternative would be similar to those described under Alternative 3.

#### 3.3.6.1.7 Alternative 5—No Action

Under the No Action alternative, methane seepage would continue to increase through the year 2030, as predicted by the 3M model in the western part of the Project Area. Seepage would increase in the eastern Project Area because CBM development would occur on fee and private minerals. The extent of the outcrop affected by seepage would be confined, however, to areas immediately updip (upslope) of the fee and private minerals that would be developed.

As with the other alternatives, concentrations of methane may increase in up to 20 shallow domestic wells, even with the current well field. These impacts may come later in the field development, however, compared with the other alternatives, because no additional wells would be permitted on federal land. In addition, fewer CBM wells located near the outcrop may delay the impacts on some of the shallow water wells.

### 3.3.6.2 Surface Water

Surface water that is affected by CBM development is limited to small springs emanating from the Fruitland Formation and the Pictured Cliffs Sandstone. Larger bodies of surface water (Texas Creek; the Animas, Pine, and Florida Rivers) are already subject to methane seepage from naturally occurring methane seeps and from the current CBM well field. These seeps are not predicted to increase in overall rate. Therefore, methane seepage from additional CBM development would not affect these surface water bodies.

It is possible that springs emanating from the Kirtland Shale and the Lewis Shale may be affected by methane seepage. Springs in the western Project Area have not been affected by CBM development over the past 6 years, however. (Carbon Junction, Edgemont Ranch, and other springs show no sign of active methane seepage.)

#### 3.3.6.2.1 Alternative 1—Proposed Action

Squaw Creek, at Yellowjacket Pass (Figure 3–10), may be subject to increases in methane seepage, and other unnamed springs along the eastern portion of the outcrop may also be affected by methane seepage. The Piedra River may likewise be subject to increased methane seepage (Figure 3–10).

There are no observable effects on water quality or aquatic life at the existing pre-CBM methane seeps in the Animas, Pine, and Florida Rivers. Increased methane seepage to surface water bodies is not expected to affect other resources and would have negligible effects on surface water chemistry.

#### 3.3.6.2.2 Alternative 1A

Squaw Creek, at Yellowjacket Pass, may be subject to increases in methane seepage, and other unnamed springs along the eastern portion of the outcrop may additionally be affected by methane seepage, as may the Piedra River.

There are no observable effects on water quality or aquatic life at the existing pre-CBM methane seeps in the Animas, Pine, and Florida Rivers. Increased methane seepage to surface water bodies is not expected to affect other resources and would have negligible effects on surface water chemistry.

#### 3.3.6.2.3 Alternative 1B

This alternative would have impacts similar to those described for Alternatives 1 and 1A.

#### 3.3.6.2.4 Alternative 2

Alternative 2 would likely accelerate methane seepage in surface water bodies along the outcrop of the Fruitland Formation. As the 3M study and other modeling predict, however, the intensity of the seeps would be slightly reduced, because a denser network of near-outcrop wells would be drilled. The effects of a denser well network near the outcrop are not great enough to warrant use as a mitigation measure. Uncertainties in modeling are such that slight decreases in predicted methane seepage rates are not significant and should not be used to support decisions about the design of mitigation measures.

As noted for Alternative 1, there are no observable effects on water quality or aquatic life at the existing pre-CBM methane seeps in the Animas, Pine, and Florida Rivers. Increased methane seepage to surface water bodies is not expected to affect other resources and would have negligible effects on surface water chemistry.

#### 3.3.6.2.5 Alternative 3

The impacts of this alternative would be similar to those of Alternative 1. Development would not occur in a large portion of the interior of the basin. Wells nearer the outcrop would be drilled and operated, however, thus inducing methane seepage at levels similar to Alternative 1. Surface water bodies on the outcrop of the Fruitland Formation would probably see methane seepage at levels similar to Alternative 1.

#### 3.3.6.2.6 Alternative 4

The impacts of this alternative would be similar to those of Alternatives 1 and 3.

#### 3.3.6.2.7 Alternative 5—No Action

This alternative would likely result in lower methane seepage rates to surface water in the eastern portion of the Project Area. Squaw Creek, the Piedra River, and other small groundwater seeps and springs would probably see little or no impact associated with CBM development. We expect this lack of impact because the intensity of development in the near-outcrop area would be reduced; therefore, the seepage rates would be lower. Impacts on surface water bodies in the central and western Project Area would be similar to the other alternatives, because the existing well field would continue operating and infill CBM development would continue on private leases.

## 3.3.6.3 Vegetation

Current levels of CBM development have affected an estimated 300 acres of vegetation. The total affected area is likely to increase somewhat, even under a No Action development scenario. The 3M model predicts increased methane seepage at the outcrop. Increases in methane seepage would affect larger areas of the outcrop and expand the areas of dead vegetation.

### *3.3.6.3.1 Alternative 1—Proposed Action*

The companies' alternative would probably expand the acreage of plant die-off caused by methane seeps along the outcrop of the Fruitland Formation. Alternative 1 could result in vegetation die-off on 340 acres, in addition to the 300 acres affected by the existing CBM well field.

### *3.3.6.3.2 Alternative 1A*

This alternative would likely expand the acreage of plant die-off caused by methane seeps along the outcrop of the Fruitland Formation. Alternative 1A could result in vegetation die-off on 340 acres, in addition to the 300 acres affected by the existing CBM well field.

### *3.3.6.3.3 Alternative 1B*

This alternative also would probably expand the acreage of plant die-off caused by methane seeps along the outcrop of the Fruitland Formation. Alternative 1B could result in vegetation die-off on 340 acres, in addition to the 300 acres affected by the existing CBM well field.

### *3.3.6.3.4 Alternative 2*

The 3M model indicates that increased methane seepage would occur along the outcrop, regardless of the intensity of development. Therefore, impacts associated with Alternative 2 should be similar to those described under Alternative 1. As with Alternative 1, an additional 340 acres of vegetation die-off may occur.

### *3.3.6.3.5 Alternative 3*

Impacts would be similar to those of Alternative 1.

### *3.3.6.3.6 Alternative 4*

Impacts would be similar to those of Alternative 1.

### *3.3.6.3.7 Alternative 5—No Action*

Vegetation die-off would be limited to 300 acres that the existing CBM well field is predicted to affect. Some additional acreage may be affected in the eastern Project Area because of development on fee and private mineral estate.

### 3.3.6.4 Wildlife

The impacts on wildlife habitat caused by methane seepage are largely related to the vegetation die-off.

#### *3.3.6.4.1 Alternative 1—Proposed Action*

The Companies' proposed development scenario would likely expand the acreage of habitat loss by 340 acres, for a total of 640 affected acres. The timing depends on the pace of development. The duration of this effect is unknown, because some of the methane seep areas begin vigorously and subside as production continues. Furthermore, some methane seep areas appear to persist.

Some plant life would be reestablished within several years in areas where the seeps subside. The new plant life could lead to a change in habitat, as grasses and shrubs eventually replace dead trees.

In contrast, the persistent seep areas do not allow for revegetation. Moreover, according to the results of the 3M model, these seeps may persist for several centuries. The areas affected by methane seeps should gradually be reduced, as CBM wells are plugged and abandoned and the Fruitland aquifer begins to recharge.

#### *3.3.6.4.2 Alternative 1A*

This alternative would probably expand the acreage of habitat loss by 340 acres, for a total of 640 acres affected. The timing depends on the pace of development. The duration of this effect is unknown, because some of the methane seep areas begin vigorously and subside as production continues. Some methane seep areas appear to persist.

Some plant life would be reestablished within several years in areas where the seeps subside. The new plant life could lead to a change in habitat, as grasses and shrubs eventually replace dead trees. In contrast, the persistent seep areas do not allow for revegetation. Furthermore, according to the results of the 3M model, these seeps may persist for several centuries. The areas affected by methane seeps should gradually be reduced, as CBM wells are plugged and abandoned and the Fruitland aquifer begins to recharge.

#### *3.3.6.4.3 Alternative 1B*

Impacts associated with this alternative are similar to those of Alternatives 1 and 1A.

#### *3.3.6.4.4 Alternative 2*

The affected areas are expected to be similar under the maximum-development alternative and the Companies' proposed alternative. The timing and intensity of methane seeps may differ slightly between the two alternatives. The total loss of habitat is expected to be on the order of 640 acres along the outcrop of the Fruitland Formation. This total includes 340 acres of impacts from prior development, plus 300 acres from development in the eastern portion of the Project Area.

Maximum development of the CBM resource may lead to an early reduction in the intensity of the methane seep, as the wells nearest the outcrop would intercept some of the methane that would otherwise escape to the atmosphere at the seep areas. Maximum development thus could reduce the duration and intensity of the seep locally. We do not expect, however, that increasing the density of wells near the outcrop would measurably reduce the loss of wildlife habitat.

#### 3.3.6.4.5 Alternative 3

The impacts of this alternative would be similar to those of Alternative 1. The lack of development in the roadless area would not decrease the methane seepage at the outcrop.

#### 3.3.6.4.6 Alternative 4

Impacts associated with this alternative are similar to those described under Alternative 1.

#### 3.3.6.4.7 Alternative 5—No Action

The No Action alternative would reduce impacts on wildlife associated with methane seepage, because loss or changes of habitat would not occur over the entire 640 acres estimated for the other alternatives. There would be some impacts, however, from methane seepage induced by CBM development on fee minerals in the eastern Project Area.

### 3.3.6.5 Soils

As with vegetation and wildlife, methane seepage would affect a larger area of soils with any development scenario. Methane seeps increase susceptibility to erosion, by removal of the root structure through vegetation die-offs. In addition, methane seepage may alter some physical characteristics of the soil.

#### 3.3.6.5.1 Alternative 1—Proposed Action

Because of vegetation die-off, an additional 340 acres of bare soils would be exposed on the outcrop of the Fruitland Formation, for a total of 640 acres. These soils would be susceptible to accelerated erosion.

#### 3.3.6.5.2 Alternative 1A

An additional 340 acres of bare soils would be exposed on the outcrop of the Fruitland Formation from vegetation die-off, for a total of 640 acres. These soils would be susceptible to accelerated erosion.

#### 3.3.6.5.3 Alternative 1B

Impacts associated with this alternative are similar to those of Alternatives 1 and 1A.

#### 3.3.6.5.4 Alternative 2

This alternative would also have a potential for 340 acres of additional exposed soil on the outcrop and the concomitant increased potential for erosion.

#### 3.3.6.5.5 Alternative 3

The impacts of this alternative would be similar to Alternative 1.

#### 3.3.6.5.6 Alternative 4

The impacts of this alternative would be similar to Alternative 1.

#### 3.3.6.5.7 Alternative 5—No Action

This alternative would affect less than 340 acres of soils. As noted above, current CBM development may affect up to 300 acres, and Alternatives 1 through 4 would increase this amount by as much as 340 acres. The impacts would increase under the No Action alternative, primarily associated with CBM development on fee surface in the eastern portion of the Project Area.

### 3.3.6.6 Human Health and Safety

There are two homes on the outcrop of the Fruitland Formation in the eastern Project Area, off Fossett Gulch Road, west of the Piedra River (Figure 3–11). These homes may be affected by methane seepage and buildup associated with CBM development in the area.

Other impacts on human health and safety are associated with current CBM development. We do not expect additional impacts, however, as long as La Plata County continues to monitor building activities on the outcrop of the Fruitland Formation.

#### 3.3.6.6.1 Alternative 1—Proposed Action

The two homes along Fossett Gulch Road may be affected by methane seepage, thus exposing the residents to safety risks.

#### 3.3.6.6.2 Alternative 1A

The two homes along Fossett Gulch Road may be affected by methane seepage, thus exposing the residents to safety risks.

#### 3.3.6.6.3 Alternative 1B

The two homes along Fossett Gulch Road may be affected by methane seepage, thus exposing the residents to safety risks.

#### 3.3.6.6.4 Alternative 2

The two homes along Fossett Gulch Road may be affected by methane seepage, thus exposing the residents to safety risks.

#### 3.3.6.6.5 Alternative 3

The two homes along Fossett Gulch Road may be affected by methane seepage, thus exposing the residents to safety risks.

#### 3.3.6.6.6 Alternative 4

The two homes along Fossett Gulch Road may be affected by methane seepage, thus exposing the residents to safety risks.

#### 3.3.6.6.7 Alternative 5—No Action

CBM development on fee mineral estate may affect the two homes on the outcrop of the Fruitland Formation. The potential for this impact to occur would be reduced, however, with the lower intensity of development in this area.

### 3.3.6.7 Loss of Gas Resource

All of the alternatives result in a loss of the gas resource, caused by acceleration of methane seepage at the outcrop. The methane seepage also contributes to the greenhouse gas content of the atmosphere: methane is a potent greenhouse gas. Differences among the alternatives may be assessed qualitatively using the results of the 3M model. In light of the uncertainties associated with the model predictions and model input, however, any quantitative differences between alternatives are speculative.

Below is a description, in qualitative terms, of the relative amounts of lost resource that may be expected. Year 2003 was used to establish baseline conditions and then to compare each alternative against the baseline. These baseline conditions were simulated with the year 2000 CBM well field. Table 3–4 is a summary of gas resources lost for each alternative. The discussion for each alternative points out factors that may cause these differences.

**Table 3–4 Methane Seepage Rates—Comparison of Alternatives**

| | Daily Rate (Mcfd) | Annual Rate (MMcf) | Cumulative Loss (MMcf) |
|---|---|---|---|
| Alternative 1 | | | |
| Current | 3,800 | 1,387 | 6,200 |
| Year 2030 | 4,700 | 1,716 | 59,000 |
| Alternative 2 | | | |
| Current | 3,800 | 1,387 | 6,200 |
| Year 2030 | 4,700 | 1,716 | 59,000 |
| Alternative 3 | | | |
| Current | 3,800 | 1,387 | 6,200 |
| Year 2030 | 4,700 | 1,716 | 59,000 |
| Alternative 4 | | | |
| Current | 3,800 | 1,387 | 6,200 |
| Year 2030 | 5,600 | 2,044 | 58,000 |
| Alternative 5 | | | |
| Current | 3,800 | 1,387 | 6,200 |
| Year 2030 | 4,200 | 1,533 | 53,000 |

*Likely to occur before year 2030
Mcfd = 1,000 standard cubic feet per day
MMcf = 1 million standard cubic feet

#### 3.3.6.7.1 Alternative 1—Proposed Action

The Companies' proposal would increase the amount of methane lost from seepage at the outcrop areas, because it would increase the overall number of active seeps. At present, the eastern portion of the Project Area is unaffected by CBM development. With the beginning of development, however, about 15 miles of outcrop area would be subject to increased seepage.

Alternative 1 would result in an increase of 200 million cubic feet (MMcf) of lost gas resource every year by the year 2030. The cumulative losses would be some 6 billion cubic feet (Bcf) greater than are projected from the current well field (similar to Alternative 5).

#### 3.3.6.7.2 Alternative 1A

This alternative would increase the amount of methane lost from seepage at the outcrop, because it would expand the overall number of active seeps. At present, the eastern portion of the Project Area is unaffected by CBM development. With the beginning of development, however, roughly 15 miles of outcrop area would be subject to increased seepage. Overall, resource losses would be similar to those in Alternative 1.

#### 3.3.6.7.3 Alternative 1B

Impacts associated with this alternative are similar to Alternatives 1 and 1A.

#### 3.3.6.7.4 Alternative 2

Overall, resource losses would be similar to those for Alternative 1. It is likely they may be slightly less, based on the larger number of wells nearer the outcrop. These wells would intercept some of the gas before it can seep at the outcrop.

#### 3.3.6.7.5 Alternative 3

Most of the wells near the outcrop area would be installed on 160-acre spacing, and much of the methane that seeps to the outcrop would originate from the near-outcrop areas. Therefore, we expect no differences in resource loss between Alternative 1 and Alternative 3.

#### 3.3.6.7.6 Alternative 4

Alternative 4 would likely result in a slightly lower cumulative loss than would Alternative 1. However, the average annual seepage rate is higher in the year 2030 than from other alternatives, and overall losses may ultimately exceed other alternatives (Table 3–4).

#### 3.3.6.7.7 Alternative 5—No Action

This alternative would result in a cumulative loss of 53 Bcf of gas by the year 2030 caused by methane seepage at the outcrop (Table 3–4). This amount is approximately 6 Bcf less than is predicted for Alternatives 1 through 4.

## 3.3.7 Environmental Consequences—Hydrogen Sulfide Seepage: Outcrop

As described above, no hydrogen sulfide seeps in the Project Area can be associated with CBM development. Numerous monitoring points on the outcrop immediately south and west of the Project Area show a statistically significant increase in hydrogen sulfide. There is a direct correlation between CBM well operation and large water-table drawdowns in the Fruitland Formation near the outcrop in the area southwest of the Project Area. The drawdowns are also correlated with increasing concentrations of hydrogen sulfide measured in the vapor tubes.

It is thought that the lower water table exposes previously anoxic coal beds to oxidizing recharge water. This exposure oxidizes sulfide minerals in the coals and transports the sulfate downdip. The sulfate is food for the sulfate-reducing bacteria at depth and creates hydrogen sulfide seeps.

The potential for development of hydrogen sulfide seeps can be assessed by alternative in relative terms. The following discussion, however, is based solely on data collected from vapor monitoring tubes outside of the Project Area. Therefore, it should not be considered an impact that would definitely occur.

### 3.3.7.1 Alternative 1—Proposed Action

The potential for the development of hydrogen sulfide seeps would be increased, because Alternative 1 would expand the effects of CBM development over a larger portion of the outcrop belt. Seeps of hydrogen sulfide appear to be confined to specific subsurface conditions. The larger the area of the outcrop affected by CBM development, the greater the likelihood that these conditions may be encountered.

### 3.3.7.2 Alternative 1A

As with Alternative 1, this alternative would expand the effects of CBM development over a larger portion of the outcrop belt. Consequently, the potential for hydrogen sulfide seeps to develop would be increased. The potential is increased because hydrogen sulfide seeps appear to be confined to specific subsurface conditions. The larger the area of the outcrop affected by CBM development, the greater the likelihood that these conditions may be encountered.

### 3.3.7.3 Alternative 1B

Impacts associated with this alternative are similar to Alternatives 1 and 1A.

### 3.3.7.4 Alternative 2

We expect that the potential to induce seeps of hydrogen sulfide would be slightly greater under Alternative 2, compared with Alternative 1, because more wells would be installed nearer the outcrop, thus increasing the potential for creating the conditions for generating hydrogen sulfide along the outcrop.

### 3.3.7.5 Alternative 3

The potential to induce seeps of hydrogen sulfide under Alternative 3 would be similar to Alternative 1.

### 3.3.7.6 Alternative 4

The potential to induce seeps of hydrogen sulfide under Alternative 4 would be similar to Alternative 1.

### 3.3.7.7 Alternative 5—No Action

The potential to induce seeps of hydrogen sulfide under this alternative would be lower, because a smaller area of the outcrop would be affected by CBM development, compared with Alternatives 1 through 4.

## 3.3.8 Cumulative Effects

Cumulative effects of methane seepage were discussed in detail in the previous sections relating to effects on each resource that would be affected by seepage.

For all alternatives, additional impacts from hydrogen sulfide are difficult to predict based on past experience. It is expected that highly localized hydrogen sulfide seeps will develop on the outcrop; however, to date, only two known hydrogen seeps have been identified in the project area. Only one of the seeps may be tied to CBM development.

This section summarizes the expected cumulative effects for each alternative.

### 3.3.8.1 Alternative 1—Proposed Action

The industry proposed action is likely to affect wildlife, soils, surface water, groundwater, human health and safety, and vegetation on approximately 340 additional acres on the outcrop. It will also increase the loss of gas resource to the atmosphere. Lastly, we anticipate that some additional domestic wells on the outcrop will be contaminated by methane seepage.

### 3.3.8.2 Alternative 1A

Cumulative impacts will be similar to Alternative 1.

### 3.3.8.3 Alternative 1B

Cumulative impacts will be similar to Alternative 1.

### 3.3.8.4 Alternative 2

Cumulative impacts will be similar to Alternative 1.

### 3.3.8.5 Alternative 3

Cumulative impacts will be similar to Alternative 1.

### 3.3.8.6 Alternative 4

Cumulative impacts will be less than those described for Alternative 1 because a smaller portion of the outcrop would be affected by methane seeps.

### 3.3.8.7 Alternative 5—No Action

Cumulative impacts will be less than those described for all other alternatives because a smaller portion of the outcrop would be affected by methane seeps.

## 3.3.9 Conformance to Existing Plans and Policies

For all alternatives, existing and proposed CBM development will conform with current Notices to Lessees and State and Federal regulations for gas well completion and production in the Fruitland Formation. This will continue to prevent methane seepage along gas well bores.

## 3.3.10 Mitigation and Monitoring

This section presents a monitoring program. Unless otherwise stated, the following measures will be funded by the Companies.

Mitigation measures that are technically and economically feasible have not been identified. However, at least one mitigation measure is being tested in another part of the SJB. The mitigation measure involves a series of closely spaced shallow wells immediately downdip of the coal bed outcrops. These wells will be operated under suction to recover methane as it migrates from the deeper basin region toward the outcrop. Should this technique prove technically and economically feasible, the agencies and operators will explore the applicability and necessity for implementing the mitigation measure.

### 3.3.10.1 Methane Seepage Monitoring Program

1. Continue bimonthly monitoring of 176 existing vapor tubes (soil gas flow rates, methane, oxygen, hydrogen sulfide, and carbon dioxide content in the shallow gases) by installing shallow soil vapor tubes (Figure 3–4) at 12 existing transects along the outcrop. (New tubes were added at Beaver Meadows Road and Yellowjacket Pass in 2001.)

2. Add vapor tube transects at the Florida River, Edgemont Ranch, Fossett Gulch Road, and the Piedra River area.

3. Maintain the vapor tube network (replace up to 12 tubes per year).

4. Conduct statistical-trend analysis of methane seep data annually.

5. Conduct pedestrian surveys of the outcrop annually to identify recent vegetation die-offs, map the affected areas, and sample subsurface-soil gas to evaluate whether active methane seepage is responsible for die-offs. Revegetation at previously mapped seepage locations should also be noted.

### 3.3.10.2 Groundwater Monitoring Program

1. Install 12 to 20 shallow groundwater-monitoring wells along the outcrop of the Fruitland Formation to evaluate whether the effects of CBM dewatering extend to the outcrop in all areas, or whether portions of the outcrop may be hydraulically isolated from the downdip producing areas.

2. Inventory springs, wells, and groundwater seeps (wetlands) along the outcrop of the Pictured Cliffs and Fruitland and Kirtland Formations.

3. Continue monitoring water levels at the Walker well (Texas Creek), the Meloche well (Pine River area – Kirtland Formation), and the Bureau of Reclamation piezometers in the Ridges Basin area.

4. Monitor water levels at springs and wells, measure flows at springs (download dataloggers and maintain database).

5. Collect time-series water chemistry and temperature data from producing CBM wells.
6. Install and maintain a weather-monitoring station to measure precipitation, temperature, barometric pressure, and wind speed and direction.

### 3.3.10.3 CBM Produced-Water Chemistry Time-Series Sampling

Sample producing wells located within 3 miles of the Fruitland/Pictured Cliffs contact and analyze for common ions, pH, total dissolved solids (TDS), and wellhead fluid temperature quarterly (once every 3 months) for 1 year. The initial water sample would be analyzed for the stable isotopes of hydrogen and oxygen. After the initial four samples have been collected, sampling would occur every 6 months for the next 2 years. The data would be evaluated after this 3-year period to decide whether this program should continue.

### 3.3.10.4 Water Chemistry Monitoring—Private Wells

Continue to collect water samples from approximately 70 wells every 3 years. These wells would be sampled for concentrations of methane, as well as the major cation and anion components of groundwater. Methane detected above a specified threshold level would then be analyzed for isotopic composition. The isotopic composition would be analyzed to obtain information on the origins of the methane (biogenic vs. thermogenic). This program was outlined in the HD Coalbed Methane Development EIS (FS and BLM 1992).

### 3.3.10.5 Climatic/Weather-Monitoring Station

1. Install a weather-monitoring station on National Forest System land in the HD Mountains. Data collected from this station would include wind speed and direction, barometric pressure, precipitation, and temperature. These data would be used in evaluating vapor tube flow rates and concentrations of methane, as well as for air modeling input and calibration.

2. Use precipitation data in evaluating data on water level collected at monitoring wells, springs, and seeps. Data on precipitation are critical for evaluating recharge potential along the outcrop and natural versus human-induced fluctuations in groundwater.

3. Compile and issue data reports annually.

### 3.3.10.6 Integration with Other Monitoring Efforts

1. The COGCC is conducting a monitoring effort that includes maintaining six flux pyramids, annual surveys of the outcrop, and installing and monitoring deep monitoring wells.

2. BP America is continuing to monitor the Pine River area, which consists of flux pyramids and monitoring wells. Two flux pyramids are installed in the channel of the Pine River. These locations were selected to capture methane from active seeps in the riverbed. BP also collects water-level

data from the Gurr Federal, Salmon shallow, intermediate, and deep wells, the Pole Barn monitoring well, and the Morgan's house well.

The monitoring efforts described above are intended to complement these ongoing efforts.

## 3.3.11 Unavoidable Adverse Effects

Unavoidable adverse effects are those that cannot be eliminated, even through Best Management Practices or other mitigation measures. For all alternatives, some level of methane seepage will occur; therefore, methane seepage and the inter-related effects on other resources are all considered unavoidable adverse effects.

The magnitude of these effects is described for each alternative in the previous sections.

## 3.3.12 Irreversible and Irretrievable Effects

Methane seepage at the outcrop represents an irreversible and irretrievable effect due to the methane loss to the atmosphere. Methane seepage effects on other resources, although long-term, will be time-limited. After CBM production ceases, and the groundwater recharges the coal beds, methane seepage will decrease, and in many places, it will cease.

The following table illustrates the volumes of gas lost to the atmosphere for each alternative. The volumes in this table do not represent the entire amount of gas that will be irretrievably lost, only the volumes that will be lost through the year 2030. The overall volumes lost will be somewhat greater than those shown in Table 3–5.

**Table 3–5 Methane Seepage Rates—Comparison of Alternatives**

| | Daily Rate (Mcfd) | Annual Rate (MMcf) | Cumulative Loss (MMcf) |
|---|---|---|---|
| Alternative 1 | | | |
| Current | 3,800 | 1,387 | 6,200 |
| Year 2030 | 4,700 | 1,716 | 59,000 |
| Alternative 2 | | | |
| Current | 3,800 | 1,387 | 6,200 |
| Year 2030 | 4,700 | 1,716 | 59,000 |
| Alternative 3 | | | |
| Current | 3,800 | 1,387 | 6,200 |
| Year 2030 | 4,700 | 1,716 | 59,000 |
| Alternative 4 | | | |
| Current | 3,800 | 1,387 | 6,200 |
| Year 2030 | 5,600 | 2,044 | 58,000 |
| Alternative 5 | | | |
| Current | 3,800 | 1,387 | 6,200 |
| Year 2030 | 4,200 | 1,533 | 53,000 |

*Likely to occur before year 2030
Mcfd = 1,000 standard cubic feet per day
MMcf = 1 million standard cubic feet

# 3.4 Geology and Minerals

## 3.4.1 Issues

This section discusses the affected environment and effects of CBM development to date on the geology, mineral and energy resources, and paleontologic resources of the Project Area. The following related issues were identified during the scoping process for the EIS.

*Issue 5: The effects of additional development of CBM resources on the geology, geomorphology or topography, geohazards, paleontology, and mineral resources of the Project Area.*

Sub-issues:

- Will surface disturbance associated with additional CBM development affect the landforms and physical landscapes of the Project Area?
- Will additional CBM development affect the geology of the Project Area?
- Will additional CBM development affect paleontologic resources?
- Will additional CBM development affect the mining of coal or the development of other mineral resources in the Project Area?
- Will surface disturbance associated with the construction of additional roads and well pads affect existing landslides and slope stability or increase the likelihood of new slope movements?
- Will injection of produced water affect the geologic stability of the subsurface?
- Will extraction of groundwater from the Fruitland Formation affect the geologic stability of the subsurface?
- Does hydraulic fracturing or cavitation affect the geologic stability of the subsurface?
- Will additional CBM development affect existing coal fires or increase the likelihood that new coal fires would ignite spontaneously in the Project Area?

Each sub-issue is addressed below, including the background, concerns, and effects of CBM development to date.

## 3.4.2 Affected Environment

### 3.4.2.1 Landforms/Physical Landscapes

#### 3.4.2.1.1 *Background*

*Physiography*

The Project Area lies entirely in Colorado, within the Colorado Plateau physiographic province. This province extends throughout western Colorado, northwestern New Mexico, northeastern Arizona, and southern and eastern Utah. Characteristics of this physiographic province include an expansive, dissected, high-elevation land surface with relatively low relief when compared with surrounding mountainous regions.

Canyons, cliffs, elevated plains, low plateaus, mesas, buttes, and badlands dominate the landscape of this ecological region. Arroyos, valleys, and canyons were formed by stream erosion and intense storms. Landforms such as ridges, cuestas, cliffs, steep-sided mesas, and buttes were formed by differential erosion of rocks with alternating high and low resistance to erosion, often accompanied by local folding and faulting. Features called monoclines occur where layers of relatively flat-lying younger rock have been compressed and folded upward in one direction over older, faulted rocks. Many monoclines are long, winding features with considerable relief. The continuity of rock exposures is broken locally by faults. Erosion-resistant rocks cap mesas and buttes (BLM 2000a).

Topographic relief varies from moderate to steep slopes of canyons and mesas in the north-central and south-central portions of the Project Area, to rolling hills, cuestas, and gently sloping river valleys in the eastern and western portions of the Project Area. The central part of the SJB consists of a dissected plateau that dips gently to the west and deep, steep-sided canyons formed by streams within the basin (BLM 2000a). Elevations in the Project Area increase from south to north, and range from 6,000 feet to 9,000 feet above mean sea level.

The Project Area is drained to the south by the following tributaries of the San Juan River: the Animas River and its tributary, the Florida River; the Los Pinos (Pine) River; and the Piedra River. The San Juan River is a tributary of the Colorado River.

### 3.4.2.1.2 *Concerns*

The natural land surface is disturbed during development of CBM resources. Typically, sloping ground is leveled using cut-and-fill construction methods when roads, well pads, or other facilities are built. Topsoil is first stripped and conserved for use during reclamation. Then, underlying rock fragments and solid rock are excavated from cut slopes and pushed by heavy equipment to fill slopes, where the excavated material is spread to even out the topography of a site where a facility is to be constructed. Pipelines can be constructed across the sloping surface where slopes are not too steep without the use of extensive cuts and fills. The amount of cuts and fills necessary increases with slope for all types of facilities.

The pattern of naturally occurring landforms is altered wherever excavation occurs. The topography and characteristic landforms of an area affected by construction would be restored during reclamation; however, restoration would be approximate because of the limitations of replacing "unbroken or in-place material" with loose material that takes up more space and may not hold the same form. Some modifications to the landscape may be necessary during reclamation to control future erosion or to facilitate revegetation of disturbed areas.

#### 3.4.2.1.3 *Effects of CBM Development to Date*

CBM development has impacted the land surface of an estimated 523 acres to date within the Project Area. The existing disturbance is the result CBM well pads – 310 acres; access roads, pipelines, and utilities – 193 acres; injection well pads – 8 acres; and gas compression facilities – 12 acres. Impacts to landforms and physical landscapes may occur where construction takes place and will be most evident where slopes are steepest (and where cuts and fills would be largest). The impacts associated with landform disturbance are very minor and are discussed in more detail in the Visual Resources Section of this chapter.

## 3.4.2.2 Geology

### 3.4.2.2.1 *Background*

#### *Structure and Geology*

The San Juan Basin is an asymmetric basin about 200 miles long (north-south) and 130 miles wide (east-west) that is filled with sedimentary rocks. The deepest part of the basin, near the Colorado-New Mexico state line, is filled with up to 14,000 feet of sedimentary rocks (BLM 2000a). The Fruitland Formation is exposed near the margin of the basin in a series of outcrops that extend 90 miles across southwestern Colorado. Sedimentary rocks have been upturned in this area (BLM 2000a). The erosion of the Oligocene volcanic and volcaniclastic rocks over the upturned outcrop of the Fruitland Formation along the northern flank of the basin exposed the sandstones and coals of this formation (Laubach and Tremain 1994b). Fruitland coals are present throughout the subsurface of the basin to a maximum depth of slightly more than 4,000 feet (Fassett et al. 1997). The Animas and San Jose Formations that fill the SJB were formed by the deposition of sediments transported from the uplifted area to the north.

Minor folds occur throughout the basin and are especially apparent where the regional dip changes, such as near the Hogback monocline and at the periphery of the basin floor (Ayers et al. 1994). Natural fractures (joints and cleats) are widespread in Cretaceous and Tertiary rocks of the SJB (Laubach and Tremain 1994b) and consist of local fractures of tectonic origin and of fractures caused by compaction that occurred as coal formed (Ayers et al. 1994). The structural setting of the Project Area is described in Ayers and Kaiser (1994).

Local folds form structural traps for coal bed methane. Localized structural deformation caused fractures that may offset coal beds. Fractures that formed during folding may enhance coal bed permeability. These minor folds and faults caused fractures that may enhance the movement of water and gas through coal beds or may offset coal beds against rocks with lower permeability and impede the movement of gas or water. Ayers and Zellers (1994) evaluate the impact of basin structures on the occurrence of coal bed methane.

Laubach and Tremain (1994a) describe fracture patterns in the northwestern portion of the SJB. Along the northwestern margin of the SJB, the west-northwest and northeast trends of fracture zones may coincide with permeability that is greater in the direction of cleat orientation than in other directions. Locally, prominent fractures in the Pictured Cliffs Sandstone extend into overlying Fruitland coal seams, where they are marked by more fractures with better interconnections and small normal faults. Permeability may be enhanced in these areas.

Structural features expressed in the Cretaceous strata that could affect movement or water or gas were considered in the 3M CBM model (Questa 2000) when their existence could be demonstrated by evidence or inferred by multiple reasons. No structural features were added to Questa's model in the Project Area. Structural features occurring outside the Project Area, including the Valencia Canyon and 44 Canyon faults southwest of Durango, may compartmentalize coal reservoirs near the northwestern margin of the basin and impede movement of water and gas (Ayers and Kaiser 1994, Applied Hydrology Associates 2000).

The only basement fault shown in the Project Area, which exhibits a surface trace of about 6 miles occurring along a west-northwest trend near Bayfield (Taylor and Huffman 1998), is not expressed in Cretaceous strata and therefore is not relevant to this analysis. Other regional geology maps do not show any faults in the Project Area (Steven et al. 1974, Green 1992, Van Loenen et al. 1997, Day et al. 1999). The locations where drainages cut through the Hogback monocline may represent the surface traces of faults. These locations include the Los Pinos River, Animas River, Florida River, Texas Creek, and Piedra River. However, published geologic maps, such as Fassett et al. (1997) which examines methane seep areas along some of these drainages in detail, do not show any mapped faults.

Unconsolidated surficial deposits (Quaternary deposits) overlie bedrock in some areas. Bedrock consists of layers of consolidated sedimentary rocks that form Cenozoic- and Mesozoic-age geologic formations. Geologic formations are sequences of rock layers that are recognizable over large areas. Depositional environments for the Cenozoic and Mesozoic formations described below included deep to shoreline marine environments and mostly fluvial continental environments. The rock types (lithology) associated with Cenozoic- and Mesozoic-age geologic formations occurring in the Project Area are described by Green 1992, Carroll et al. 1999, and Wray 2000.

The descriptions of these layers (stratigraphy) are summarized below. Formations are listed from youngest to oldest by their formal name. Geologic ages of the formations are shown in parentheses. Figure 3–12 shows the surface geology of the Project Area. A stratigraphic column for the NSJB is shown on Figure 3–13.

**Cenozoic Era** – Surficial deposits and geologic formations deposited from the present to sixty five million years ago.

**Quaternary Deposits** – These unconsolidated rock grains and clasts (rocks) were deposited during the last 1.8 million years before the present (CGS 2001). The grain or clast sizes and geologic processes characteristically associated with surficial deposits in the Project Area are listed below. Most types of surficial deposits occurring in the Project Area are poorly sorted by grain or clast size. Surficial deposits include the following types of unconsolidated deposits:

**Alluvial** – silt, sand, gravel, and cobbles deposited by steams and rivers in channels, fans, terraces, or floodplains;

**Colluvial** – clay, silt, sand, gravel, or cobbles deposited downslope by gradual gravity movement or sheetwash;

**Landslide** – clay, silt, sand, gravel, cobbles, boulders, rock debris, or rock masses deposited downslope by movement that can be sudden or continuous and slow;

**Glacial** – clay, silt, sand, gravel, cobbles, or boulders deposited by moving or melting glaciers;

**Eolian** – ash, clay, silt, or sand deposited by wind as loess (wind-blown soil) or sand dunes; and

**Lacustrine** – ash, clay, or silt deposited in lakes.

**Tertiary Formations** – These geologic formations were deposited between about two and sixty five million years ago.

**San Jose Formation (Eocene)** – This stratigraphic sequence is of fluvial origin and consists of interbedded siltstone, light sandstone, and dark varicolored shales. Sandstones are arkosic (contain the mineral feldspar) and massive. This formation generally overlies the Nacimiento Formation.

**Nacimiento Formation (Paleocene)** – This unit consists of interbedded dark shales and light sandstones that were deposited by meandering rivers along a braided alluvial plain. Sandstones are arkosic. The Nacimiento Formation is not exposed within the Project Area, but does contain fossils where it occurs in the central SJB.

**Animas Formation (Paleocene and Upper Cretaceous)** – This stratigraphic sequence of fluvial origin consists of gray-green to reddish brown sandstone, shale, and conglomerate that contain abundant volcanic materials, including tuffaceous (ash) interbeds, grains, and clasts. This unit also contains abundant petrified wood.

**Mesozoic Era** – Generalized listing of geologic formations deposited between 65 and 248 million years ago.

**Kirtland Shale (Upper Cretaceous)** – This formation is of fluvial origin and has three members: an upper shale member that consists of interbedded sandy shale and light sandstone; the middle Farmington Sandstone member that consists of light sandstone with interbedded siltstone and shale; and a lower shale member that consists of dark gray shale and lenses of dark sandstone.

**Fruitland Formation (Upper Cretaceous)** – This formation was deposited in a swampy coastal plain environment and consists of interbedded sandstone, shale, coal, and altered volcanic ash. The upper part of the sequence contains fluvial sandstones and shales. The lower part consists predominantly of sandstone, coal beds, and shale. Coal beds (seams) are prevalent in the basal part of the formation.

**Pictured Cliffs Sandstone (Upper Cretaceous)** – This formation was deposited in a shallow marine environment and consists of an upper thick, massive, light sandstone that overlies light sandstones and siltstones interbedded with dark shales. The Pictured Cliffs Sandstone locally intertongues with the Fruitland Formation.

**Lewis Shale (Upper Cretaceous)** – This formation was deposited in a low-energy offshore marine environment and consists of a thick sequence of dark gray fissile (flaky) shale that contains sandstone interbeds in the upper part that are potentially gas-bearing, and basal limestone. This formation also contains clay-rich altered volcanic ash beds.

**Mesaverde Group (Upper Cretaceous)** – This sequence consists of three formations grouped together, including the Cliff House Sandstone, the Menefee Formation, and the Point Lookout Sandstone. These formations are distinguished primarily by the presence of coal beds found only within the Menefee Formation.

**Cliff House Sandstone (Upper Cretaceous)** – This formation was deposited in a shallow marine environment and consists of light calcareous (contains calcium carbonate) sandstone interbedded with shale and mudstone that weathers to form rusty-colored outcrops.

**Menefee Formation (Upper Cretaceous)** – This formation was deposited in a coastal plain environment and consists of gray, brownish, and tan sandstone interbedded with dark, carbonaceous shales and coal beds. Locally, this formation contains burned rock and clinker that resulted from burning of coal beds.

**Point Lookout Sandstone (Upper Cretaceous)** – This formation was deposited in a coastal shoreline environment and consists of a massive upper sandstone with minor shale interbeds and a lower sequence of interbedded thin sandstone and shale beds.

**Mancos Shale (Upper Cretaceous)** – Most of this sequence was deposited in a low-energy marine environment. The basal part of the sequence was deposited in a near-shore environment. This formation consists of interbedded dark shales, silty shales, clayey to sandy limestones, limey sandstones, and bentonite (clay) beds. Thin bentonite beds occur throughout, but are most abundant in the basal part of the formation. The basal part of the formation also is calcareous and includes the Greenhorn Limestone member.

**Dakota Sandstone (Upper Cretaceous)** – This formation is mostly fluvial in origin but becomes increasingly marine in origin toward the top of the sequence. High-energy fluvial deposits occur near the base of the sequence. The formation consists predominantly of fine-grained brown sandstones with carbonaceous shale partings and siltstones near the top of the sequence. Lower in the sequence, sandstones are interbedded with mudstones, carbonaceous shales, and thin coal beds. Channel sandstones with some conglomeratic beds occur near the base of the sequence.

**Burro Canyon Formation (Lower Cretaceous)** – This formation was deposited in a high-energy fluvial environment and consists predominantly of coarse-grained light sandstone and conglomeratic sandstone.

**Morrison Formation (Upper Jurassic)** – This formation is of continental fluvial and lacustrine origin. Greenish gray to reddish brown mudstone and claystone are dominant rock types in the upper part of the sequence. The lower part of the sequence contains light sandstone with thin interbeds of greenish gray mudstone. Bentonite beds also occur.

**Bluff Sandstone (Middle to Upper Jurassic)** – This formation is of continental origin and consists of a light-colored, crossbedded to massive eolian sandstone. It is correlative with the Junction Creek Sandstone.

**Wanakah Formation (Middle Jurassic)** – This sequence was deposited in a marginal marine and coastal plain environment. It consists of interbedded light to reddish colored sandstones and darker mudstones in the upper portion of the sequence and a medium to dark gray limestone in the lower portion.

**Entrada Sandstone (Middle Jurassic)** – This formation was deposited on an arid coastal plain and consists of light gray to orangish gray sandstone that typically contains prominent large-scale cross bedding.

**Dolores Formation (Upper Triassic)** – This formation was deposited in continental fluvial and lacustrine environments. It consists of an interbedded sequence of dark reddish shale and siltstone, sandstone, limestone pebble conglomerate, and rare thin limestone beds. It is correlative with portions of the Chinle Group (Moss Back Formation).

**Paleozoic** – age sequences are unlikely to be affected by development of CBM resources. The deepest formations that may be affected by development of CBM would be Mesozoic units that underlie the Fruitland Formation and contain zones where produced water could be injected. The oldest formation that has been used for injection within the Project Area is the Middle Jurassic Entrada Sandstone (COGCC 2002a).

#### 3.4.2.2.2 *Concerns*

Surface geology consists of the pattern of naturally occurring rock outcrops and surficial deposits in an area. Naturally occurring outcrops and deposits would be altered wherever surface exposures are excavated. The stratigraphy, structure, and contacts between geologic units in the Project Area would not be changed, however.

#### 3.4.2.2.3 *Effects of CBM Development to Date*

Development of CBM to date in the SJB has altered naturally occurring rock outcrops and deposits where surface exposures have been excavated to construct roads, drilling locations, or facilities. The stratigraphy, structure, and geologic contacts in the Project Area have not been affected.

### 3.4.2.3 Paleontologic Resources

#### 3.4.2.3.1 *Background*

Paleontologic resources (fossils) constitute a fragile and nonrenewable scientific record of the history of life on earth. The BLM and FS have applied agency requirements to ground-disturbing activities to protect paleontologic resources and the scientific values they contain. Avoidance of significant sites is the preferred mitigation for adverse effects to paleontologic resources.

Several formations in the Project Area may contain significant fossil resources. Table 3–6 shows known fossil resources by geologic unit within the BLM's San Juan Resource Area, which includes the NSJB and the Project Area.

#### 3.4.2.3.2 *Concerns*

Paleontologic resources, once disturbed, lose much of their preserved information. Although fossils are rarely one of a kind, a limited number of specimens are preserved in any geologic formation. These resources cannot be used for scientific study if they have been damaged, destroyed, or removed without proper scientific documentation. The greatest potential for impact to surface and subsurface fossils would come from excavation of surface deposits or bedrock. Both surface and subsurface fossils could be damaged or destroyed during ground-disturbing activities. Ground-disturbing activities could result in a loss of resources or scientific values unless field survey is used to document, and remove for study where necessary, any significant paleontologic resources that could be affected.

#### 3.4.2.3.3 *Effects of CBM Development to Date*

CBM development to date is not known to have damaged or destroyed significant paleontologic resources. The BLM and FS require surveys of all areas where ground-disturbing activity is proposed when significant paleontologic resources are known to occur. Lease provisions and APD conditions of approval require protection and prompt reporting of paleontologic resources discovered during project activities. Operations must be suspended until an evaluation that addresses discovery and mitigation is completed. In addition to potential adverse impacts during construction, significant fossils may become exposed during subsequent erosion of freshly excavated rocks. The agencies may recommend post-excavation paleontologic inspections, depending on the results of any pre-construction site survey.

**Table 3–6 Paleontologic Resources of the San Juan Resource Area**

| Major Geologic Units | Known Fossil Resources |
|---|---|
| Quaternary Alluvium | Shrub Ox |
| San Jose Formation | Diverse early Eocene vertebrate fossils along the eastern margin of the SJB |
| Nacimiento Formation | Brachiopods; fish, crocodiles, turtles, various mammals, and temperate flora in central SJB, outside Project Area |
| Animas Formation | 59 species of fossil plants, consisting of 3 ferns, 1 palm, 55 dicots; various vertebrates including *Triceratops*, *Discoscaphites*, and *Sphenodiscus*; abundant petrified wood; typical late-Paleocene mammalian fossils |
| Kirtland Shale | Baculites; various vertebrates, invertebrates, and plants in western SJB |
| Fruitland Formation | Baculites, vertebrates including dinosaurs; various vertebrates, invertebrates, and plants in western SJB |
| Pictured Cliffs Sandstone | Ammonites, cephalopods, baculites, ophiomorpha burrows, palm fronds, leaf impressions, petrified and carbonized palm wood |
| Lewis Shale | Ammonites, baculites, partial skeleton of a mosasaur, *Exiteloceras* |
| Mesaverde Group, undivided | Theropod dinosaur tracks, baculites, scaphites |
| Cliff House Sandstone | Ammonites, crustaceans, clams, oysters, snails, starfish, sea urchins, shark teeth, amphibians, turtles, mosasaur, plesiosaur |
| Menefee Formation | Leaf impressions, palm fronds, conifers, reptile bones, fossil tree trunk |
| Point Lookout Sandstone | Worms, crustaceans, clams, ammonites, various animal tracks, driftwood |

Adapted from: BLM et al. 2000, Carroll et al. 1999, Kues and Lucas 1987.

## 3.4.2.4 Coal and Other Mineral Resources

### 3.4.2.4.1 *Background*

Mineral and energy resources that occur in the Project Area include oil, natural gas, coal, geothermal resources, sand, and gravel. The SJB of Colorado and New Mexico is the second-largest natural gas field in the United States. Since 1951, development of natural gas has been an important factor in local economies. CBM development in the SJB accelerated during the mid-1980s and has continued to the present. CBM is currently the primary focus of natural gas development in the SJB. Several coal mines that are inactive or abandoned are located within the Project Area. In addition, thermal springs occur within the Project Area. Finally, several active sand and gravel operations are located within the Project Area.

### 3.4.2.4.2 Conventional Oil and Gas Exploration and Development

The Ignacio-Blanco field, which produces from the Dakota Sandstone, Fruitland Formation, Pictured Cliffs Sandstone, and the Mesaverde Group, was discovered in 1950. The Dakota Sandstone, Mesaverde Group, and Pictured Cliffs Sandstone are the principal producing horizons and typically yield dry gas with small quantities of produced water and associated hydrocarbon liquids (BLM et al. 2000). By 1995, the Dakota Sandstone had produced 279 Bcf of gas. Production from the Dakota Sandstone reached its peak in 1996, but this formation may still have potential for limited development. The Mesaverde Group produced 678 Bcf of gas and 40,000 barrels of condensate from 1952 to 1995. Wells completed in the Pictured Cliffs Sandstone, which includes the Pictured Cliffs Sandstone and Fruitland Sand, produced 88 Bcf through 1995 (BLM et al. 2000).

As of December 2001, 13 active conventional gas wells exist in the Project Area within the Ignacio-Blanco field. Figure 3–12 shows the locations of the conventional wells within the Project Area (listed as Existing Non-Fruitland Wells).

#### *Coal Bed Methane*

CBM is a by-product of the evolution of plants into coal. The influence of heating and pressure when organic debris is buried beneath thousands of feet of sediments causes CBM and coal to form. CBM is contained in and adsorbed to the coal until the pressure within the coal bed is reduced by removing groundwater, liberating CBM.

CBM occurs where the coal bed serves as both the source rock and the storage reservoir for methane gas. Methane is the primary component in CBM that is produced from the SJB; however, water, carbon dioxide, wet gasses (such as ethane, propane, and butane), nitrogen, and liquid hydrocarbons are also present in smaller quantities (BLM et al. 2000). Coal beds found within the Fruitland Formation are considered the most significant reservoirs for development of CBM within the SJB. The Menefee Formation also contains coals that may yield CBM, but only limited production has been recorded when compared with the Fruitland Formation (BLM et al. 2000).

Estimates for in-place CBM resources within the SJB include 50 trillion standard cubic feet (Tcf) in the Fruitland Formation and 34 Tcf in the Menefee Formation (BLM et al. 2000). Production from the Fruitland Formation to date (2000) exceeds 6 Tcf when the New Mexico portion of the SJB is included (BLM et al. 2000).

The first CBM wells in the SJB were drilled into the Fruitland and Menefee Formations in 1948, and production was first recorded in 1951. Until the mid-1980s, inadequate technology for extraction of coal gas and the lower heating value (BTU) made CBM from the Fruitland Formation uneconomical to develop (BLM et al. 2000). Widespread CBM development began in the mid-1980s, after the Crude Oil Windfall Profits Tax provided tax incentives for operators to overcome technical problems associated with production of CBM (BLM et al. 2000).

Approximately 1,000 CBM wells were drilled in the Colorado portion of the SJB by 1999, including new wells and conventional gas wells plugged and recompleted in the coal beds of the Fruitland Formation, under COGCC Spacing Order

No. 112–61. The order specifies a well spacing of 320 acres (BLM et al. 2000). Figure 3–12 shows the locations of all existing CBM wells in the Project Area. As of December 2002, approximately 310 active or approved CBM wells target the Fruitland Formation in the Project Area. CBM-produced water is injected at five disposal wells located in the Project Area (COGCC 2002a). Two other disposal wells are classified as shut in (COGCC 2002a).

### Coal

Coal is found within the Dakota Sandstone, Menefee Formation, and Fruitland Formation within the Project Area. The Menefee and Fruitland Formations contain the only coal beds that are thick enough to be considered viable resources in the NSJB. The Dakota Sandstone coals are thin, discontinuous, and have a high ash content (BLM et al. 2000). Some very thin coal beds also have been noted in water wells completed within the Animas Formation (COGCC 2000a).

In the past, coal mining was much more important in the NSJB than it is today. Most coal has been produced from the Menefee Formation, with a small portion of production from the Fruitland Formation. Historical coal production was almost exclusively from underground mining, with the exception of two surface mines that have been inactive since the late 1980s (Carbon Junction Strip Mine and Chimney Rock Coal Mine).

No active coal mines are located within the Project Area. Inactive or abandoned coal mines located in the Project Area are shown on Figure 3–12. The Carbon Junction Strip Mine, located along the outcrop of the Fruitland Formation east of Durango (Figure 3–12), produced 21,000 tons of coal from the Fruitland Formation before mining was terminated in 1988 (Carroll et al. 1999). The Chimney Rock Coal Mine located in the southeastern portion of the Project Area has been inactive since 1985. The operating permits for the Chimney Rock Coal Mine were terminated in 1999 (CDMG 2002). Chimney Rock has been undergoing reclamation since 1985 and in 2002 was in its final year of reclamation that began in 1991 (Koblitz 2002).

Outside the Project Area, coals in the Fruitland Formation are strip mined at the La Plata Mine in the New Mexico portion of the SJB. A few small, private mines also are operating along the outcrop of the Fruitland Formation and Hogback monocline in the SUIT Reservation (Lawson 1998). The Menefee Formation was being actively mined as of January 2002 at the underground King Coal Mine, located west of the Project Area (CDMG 2002).

### Geothermal Resources

Most geothermal resources in Colorado are low temperature. Geothermal resources that occur in the Project Area and surrounding areas consist of warm water emanating from springs or wells. Most warm springs are located near faults that serve as conduits for upward flow of groundwater that has been heated by circulation deep below the surface (Trautner et al. 2001).

Several warm springs surface along the valley margins of the Animas River. Trimble Hot Springs and Pinkerton Hot Springs, located north of the Project Area along the Animas River, are commercially and industrially developed for bathing and space heating (Barrett and Pearl 1976, Geo-heat Center 2002). Flow at Trimble Hot Springs is a few gallons per minute (gpm). The resort is served by a shallow well pumping about 260 gpm. TDS range from about 1,600 to 3,300 mg/L. Reported temperatures range from 90 to 124 °F (Trautner et al. 2001).

Hickerson Hot Spring is located outside the Project Area along the valley margin of the Animas River in Section 10, T. 35 N., R. 9 W. (Carroll et al. 1999, Trautner et al. 2001). This spring issues from a pipe in an opening to an old mine within a limestone layer near the base of the Wanakah Formation (Carroll et al. 1999) or possibly from the Entrada Sandstone or overlying Pony Express Limestone (BLM et al. 2002).

### *Sand, Gravel, and Aggregate*

Sand and gravel are typically found in floodplain and terrace deposits along rivers and streams. Many well-indurated rocks are well suited for use as aggregate when crushed. Clinker (burned coal and surrounding rock) frequently is used as aggregate. Sand, gravel, and aggregate are surface mined, primarily for use in construction and road maintenance. Active sand, gravel, and aggregate mines in the Project Area are shown on Figure 3–12.

### 3.4.2.4.3 *Concerns*

Mineral and energy resources are non-renewable and occur in limited locations. Conflicts with development of these resources might reduce their availability or cause an economic impact. The potential for conflict or coordinated development exists where economically important coal and CBM resources are found in the same area.

The injection of CBM produced water into disposal wells could affect the quality, quantity, or temperature of geothermal wells or springs within the area of influence for the disposal well. Conditions at geothermal wells or springs can change miles from a disposal well for CBM produced water.

### 3.4.2.4.4 *Effects of CBM Development to Date*

An estimated 1,676 Bcf of CBM have been produced from 1,248 wells in the Colorado portion of the SJB through 1998 (Questa 2000). This production represents an estimated 8.6 percent of the in-place reserves of CBM within the SJB.

To date, no impacts to coal mines or sand, gravel, or aggregate mining operations located within the Project Area have been attributed to development of CBM resources.

In 1989, a disposal (injection) well located nearly 9 miles south of Hickerson Hot Spring began injecting water into the Entrada Sandstone, the unit just below the Wanakah Formation (BLM 2000a). The injection pressure at the well was increased in 1993 to drive the water (BLM 2000a; Trautner et al. 2001). In 1997, the spring's owners reported that the flow rate and temperature of the spring had increased over the last 5 years and that the water had become too hot for customary household use (BLM et al. 2002). Temperatures as high as 133 °F and flows to 65 gpm were documented at that time (BLM et al. 2002). Chemical analysis indicated an increase in sodium and sulfate content as compared with a 1970 test (BLM 2000a).

Injection into the Entrada Sandstone stopped in January 1999, based on test results from the disposal well and other uncertainties regarding the well that were addressed by COGCC, EPA, and the CBM operator. The water temperature of Hickerson Hot Spring declined from 132 or 133 °F (observed between December 1997 and January 1999) to 127 °F by August 1999 (BLM et al. 2002). The flow rate decreased to 49 gpm, the lowest observed since monitoring began in November 1997. The changes observed at the Hickerson Hot Springs occurred immediately after injection was terminated at a disposal well located nearly 9 miles away.

## 3.4.2.5 Landslides and Slope Stability

### 3.4.2.5.1 *Background*

Landslides are slow or rapid downslope movements of rock and surficial deposits that are common throughout Colorado, including in the Project Area (CGS 1998). The landscape is altered by these events, which have many causes and forms. The types of landslides found in the Project Area include rockfalls, rockslides, rotational slumps (in both soil and rock), earth flows, mud and debris flows, and shallow soil slips. The landslides result from a combination of factors, including mountainous terrain, rock type and composition, weakening of the rock from weathering, orientation of the geologic structure relative to ground slope, and groundwater conditions.

The landslide hazard in most of the Project Area is low. However, where steeper slopes occur, such as near the Hogback monocline and in the HD Mountains, numerous landslides have been mapped by the USGS, CGS, and FS. Landslides mapped by these agencies within or adjacent to the project area are shown in Figure 3–14.

The landslides near the Hogback monocline mostly occur in the Fruitland Formation, with some movement of the overlying Kirkland Shale. An example located near the Project Area is the “Moving Mountain” slide just south of Durango. Newspaper accounts from 1932 indicate that this landslide was associated with explosions. The movement of the slide followed the outcrop of the Fruitland Formation along one limb of the steeply dipping hogback. Several of these landslides, including Moving Mountain, started as rockslides, transitioned into debris flows as they moved down the hillside, and formed depositional debris fans where the slope flattened.

The mapped landslides within the Project Area in the HD Mountains are in the Animas and San Jose Formations as well as some of the slides described previously near the Hogback monocline. Shale layers are interbedded with more resistant sandstone in both the Animas and the San Jose Formations. The Animas Formation also contains layers of volcanic ash. These shale and ash layers weather quickly and form surfaces of weakness that contribute to landslide formation, particularly where the sedimentary bedding surfaces are approximately parallel to ground that is moderately or steeply sloping.

Landslides also occur in the San Jose and Animas Formations where the orientation of the bedding is close to horizontal. For example, landslides within the Project Area have developed in colluvium below cliffs formed by the massive sandstone of the San Jose Formation. Rockfall, rockslides, and debris avalanches increase the weight of material at the top of the slopes below the cliffs, resulting in large, deep-seated landslides of unconsolidated material moving over weathered sandstone and shale. Most of the slopes in the HD Mountains below steep slopes or cliffs of the San Jose Formation were formed by landslides, although subsequent weathering and erosion have obscured some of the characteristic features.

Shallow translational landslides that transition into mud and debris flows are common on steeper slopes that are underlain by the San Jose and Animas Formations. Many of the mapped landslides exhibit fresh cracks in the ground, sparsely vegetated scarps, and leaning trees that indicate recent movement. Nearby slopes with similar geologic and topographic characteristics are potentially unstable and could be destabilized with disturbance or an increase in precipitation. Based on a FS analysis of landslides mapped by the USGS and CGS, slopes steeper than 40 percent that are underlain by the San Jose Formation and slopes steeper than 30 percent that are underlain by the Animas or Fruitland Formations or the Kirkland Shale are classified as areas of high landslide hazard.

#### 3.4.2.5.2 *Concerns*

Road, pipeline, and well pad construction can cause new or renewed movement of landslides. Prevention of human-induced mass movement depends, in part, on avoiding additional disturbance to existing landslides and areas susceptible to movement. Landslides could damage the environment and CBM facilities. Adverse environmental effects could then result from damaged CBM facilities.

#### 3.4.2.5.3 *Effects of CBM Development to Date*

To date, no increased movement of existing landslides or development of new landslides within the Project Area has been attributed to CBM development. However, almost all of the previous development has occurred in areas of low landslide hazard.

### 3.4.2.6 Subsurface Geologic Stability and Water Injection

#### 3.4.2.6.1 *Background*

Geologic stability of the subsurface considers the potential effects of earthquakes in the Project Area and the risk that earthquakes could be caused by CBM development.

##### *Earthquake Hazards*

Colorado is considered a region of minor earthquake activity; the southwestern corner of the state, which is part of the stable Colorado plateau, has experienced no fault activity in historical times (USGS 2001). The nearest notable faults that are potentially active occur more than 155 miles from the Project Area.

A moderate (5.5 magnitude) earthquake in 1996 centered in Dulce, New Mexico, was the closest significant earthquake to the Project Area and was felt throughout much of southern Colorado. Other minor earthquakes that caused little or no felt effects or damage have occurred within 155 miles of the Project Area (Kirkham and Rogers 2000). A few epicenters of earthquakes with magnitudes that measured 5.9 and lower have been located in La Plata and Archuleta Counties (CGS 1999).

#### *Risk of Earthquakes Caused by Underground Injection*

EPA has regulated underground injection (and by some states on behalf of EPA) since 1974, when the Safe Water Drinking Act was enacted. Regulation minimizes the risks associated with disposal (injection) wells by controlling the spacing of injection wells and the volume of fluids injected. Thus, fluids can enter the rock formation without causing an excessive buildup of pressure or fracturing rocks that could cause an earthquake. Until 1974, controls on injection wells were inadequate. Many examples exist of environmental impacts that resulted from fracturing of rock layers or release of built-up pressure caused by injection. However, there have been no known occurrences of earthquakes induced by injection of CBM-produced water in the SJB.

One well-known example of earthquakes that were associated with a disposal well near an active fault is from during the 1960s in the Denver, Colorado, area. A 12,000-foot injection well was drilled at the Rocky Mountain Arsenal in 1961, and injection began in 1962. Between 1962 and 1968, a large number of earthquakes of moderate magnitudes occurred, some causing significant damage. The largest earthquakes, magnitude 5.0, 5.2, and 5.3 tremors, occurred in 1967. Fluid was removed from the injection well in 1968. No significant earthquakes were recorded after fluid had been removed from the injection well (CGS 1999, Kirkham and Rogers 2000).

### 3.4.2.6.2 *Concerns*

No linkage has been established between CBM development in the SJB and a risk of earthquakes caused by injection of produced water. EPA regulations are designed to control injection so that there is no buildup of pressure from injected fluids that could cause an earthquake if the pressure were released suddenly.

### 3.4.2.6.3 *Effects of CBM Development to Date*

Earthquakes occurring in Colorado since about 1962 (prior to the beginning of CBM development) have been recorded by seismographs (USGS 2001). There have been no recorded occurrences of earthquakes induced by injection of CBM produced water in the Project Area. No evidence has been found to date that links CBM development in the SJB with a risk of earthquakes caused by injection of CBM-produced water.

## 3.4.2.7 Subsurface Geologic Stability and Water Extraction

### 3.4.2.7.1 *Background*

Subsidence has been associated with compression of aquifers (Galloway et al. 1999, Case et al. 2000) and with compression of unconsolidated layers (Galloway et al. 1999). Consolidation occurs over time as the forces of gravity act on the sediments that have been deposited. During consolidation, water is expelled and the sediments are compacted into consolidated rock. The water expelled during consolidation is often referred to as the "water of compaction." Case et al. (2000) describe the potential for minor aquifer compression and subsidence to occur in consolidated rocks because of planned development of CBM in the Powder River Basin (PRB) of Wyoming, a structural basin that contains a thick sequence of sedimentary rocks.

Galloway et al. (1999) describe land subsidence in the United States, including land subsidence that results from compaction of aquifer systems when groundwater is removed. Land subsidence is a gradual settling or sudden sinking of the earth's surface. Unconsolidated aquifer systems that contain a sufficient thickness of fine-grained sediments (silts and clays) are susceptible to compaction and subsidence. The compaction of aquifer systems is a principal cause of more than 80 percent of the subsidence that has been identified in the United States.

Pore space is lost when large-scale drawdown of an unconsolidated aquifer occurs for the first time. The aquifer system is compacted as pore fluid is squeezed out of the surrounding fine-grained sediments and into the aquifers (Galloway et al. 1999).

Galloway et al. (1999) correlate long-term declines in groundwater levels and land subsidence with the release of the water of compaction from compacting layers. "Long-term groundwater level declines can result in a vast one-time release of 'water of compaction' from compacting aquitards that manifests itself as land subsidence. This 'water of compaction' cannot be reinstated by allowing water levels to recover to their predevelopment status. The reduction of fluid pressure in the pores and cracks of aquifer systems, especially in unconsolidated rocks, is inevitably accompanied by some deformation of the aquifer system.

"...Almost all the permanent subsidence occurs due to the irreversible compression or consolidation of aquitards. ...In confined aquifer systems the volume of water derived from irreversible aquifer compaction is essentially equal to the volume of subsidence and can typically range from 10 to 30 percent of the total volume of water pumped. ...Seasonal displacements in land surface of up to one inch are in response to the seasonal changes in groundwater pumpage."

Significant ground subsidence has occurred where unconsolidated alluvial aquifers have become compressed through dewatering. In the United States, subsidence of the ground surface related to withdrawal of fluid has been documented at a number of localities, including the San Joaquin Valley in California and the Las Vegas area in Nevada (Galloway et al. 1999). The areas share a common geological tie in that they are underlain by saturated, unconsolidated sands and gravels with interbeds or overlying beds of saturated clays. Water removed from the aquifer by pumping caused ground subsidence.

As noted, Case et al. (2000) describe conditions in the PRB of Wyoming, a structural basin that contains a thick sequence of consolidated sedimentary rocks. The SJB is also a structural basin that contains a thick sequence of consolidated sedimentary rocks. Like the Fort Union Formation in the PRB, the Fruitland Formation in the SJB is a consolidated rock unit and is being only partially dewatered. The bedrock that underlies the surface is compacted and consolidated. Instead of loose sand, sandstone is present; instead of unconsolidated clay, shale is present.

A formula used by Case et al. (2000) to calculate the amount of aquifer compression in the PRB requires a value for change in head (drawdown). In the PRB, pre-development water levels in water wells have been incorporated into a three-dimensional groundwater flow model with aquifer characteristics, geologic cross sections, topography and surface drainages, production data, and monitoring data for water levels from ongoing development of coal and CBM (BLM 1999). This complex groundwater model addresses water production, regional flow, and leakage among aquifer units, and has been used to project drawdown of static water levels in wells that could be anticipated based on planned development of CBM (BLM 1999). Existing aquifer compression in the NSJB cannot be calculated in the manner presented by Case et al. (2000) since a three-dimensional groundwater flow model that could be used to project drawdown has not been developed for the NSJB.

Case et al. (2000) found that minor aquifer compression up to 0.5 inch could occur near Gillette, Wyoming, where nearly 6,000 CBM wells in the PRB develop much thicker coals and produce much more water. Aquifer compression that has resulted from CBM development to date in the NSJB (310 wells) likely would be much less than would be expected from development of nearly 6,000 wells in the PRB, or much less than 0.5 inch.

#### 3.4.2.7.2 *Concerns*

Removal of groundwater has the potential to cause noticeable subsidence in some geologic settings; however, the setting of the Fruitland Formation in the SJB is not conducive to noticeable aquifer compression. Galloway et al. (1999) report that seasonal fluctuations in displacement of the land surface of up to 1 inch can occur in response to seasonal changes in groundwater pumpage. The potential compression that could be associated with CBM development in the NSJB likely would be much less than the 0.5 inch that Case et al. (2000) projected for the PRB. Furthermore, it would not be noticeable in comparison with seasonal displacements of the land surface noted by Galloway et al. (1999).

#### 3.4.2.7.3 *Effects of CBM Development to Date*

No evidence to date has been found that ground subsidence has resulted from production of CBM and water from the Ignacio Blanco Field (BLM et al. 2000). In addition, no noticeable or measurable aquifer compression or ground subsidence has been observed in the NSJB to date. Development of CBM in the NSJB to date is not associated with a risk of noticeable aquifer compression or ground subsidence.

## 3.4.2.8 Subsurface Geologic Stability and Hydraulic Fracturing/Cavitation

### 3.4.2.8.1 *Background*

Small fractures are generated during well completion by hydraulic fracturing when the producing formation immediately surrounding the CBM well bore does not contain enough natural cleats or fractures to facilitate movement of gas toward the CBM well. In hydraulic fracturing, tiny sand grains, aluminum pellets, glass beads, or similar materials are carried in suspension by pressurized water and are forced out into the formation through perforations in the well's production casing. Only a limited area surrounding the CBM well bore is affected by this activity. Hydraulic fracturing is designed not to disrupt the structural integrity of the coal seam or the surrounding formations.

COGCC and BLM requirements for well drilling procedures ensure that each formation remains as isolated as it is under natural conditions and that the integrity of the well bore stays intact. The enlarged well bore in open-hole completions that use cavitation completion methods is designed not to disrupt the structural integrity of the coal seam or the surrounding formations, since production of CBM depends on the integrity of the cleats (the system of small fractures that occur naturally in the coal).

### 3.4.2.8.2 *Concerns*

No link between the use of cavitation or hydraulic fracturing to complete CBM wells and the stability of subsurface formations has been established.

### 3.4.2.8.3 *Effects of CBM Development to Date*

No effects on geologic stability have been attributed to the use of hydraulic fracturing or cavitation completion methods during CBM development.

## 3.4.2.9 Coal Fires

### 3.4.2.9.1 *Background*

Coal fires often occur naturally where coal beds are exposed at the surface or lie at shallow depths. The fires can be ignited by events such as lightning strikes, campfires, and even spontaneous combustion. The surface temperature at coal fires can become high enough to generate plumes of steam in cold weather (several hundred degrees Fahrenheit). Pungent odors and high levels of carbon monoxide and sulfur dioxide often emanate from the location of the plumes. Only small amounts of methane gas are vented to the atmosphere, however, because of consumption during the combustion process (BLM et al. 2000).

No coal outcrop fires have been identified within the Project Area (Keller 2001, BLM et al. 2000). Five active coal fires have been identified in the NSJB, all within the western portion of the SUIT Reservation, south of the Project Area.

Historically, self-heating of near-surface coals has resulted in fires on coal outcrops in the region. Wildfires have been linked to two known coal fires and may ignite sub-surface coals (BLM 2000a). These two coal fires are located in areas of recent wildfires, suggesting that surface flames may have followed tree roots into the soil, igniting sub-surface coals. Conversely, the burning coal can ignite a wildfire when underground coal fires break out on the land surface and continue burning above ground. Evidence from one coal fire indicates a possible linkage between dewatering of coal seams and resurgence of coal fires (BLM 2000a).

Seasonal fluctuations in the water table or lowering the water table in the coal beds because of CBM development exposes coals to oxygen, causing oxidation to occur and releasing heat. The exposure of dry coals to moisture also produces heat. It is virtually impossible to establish whether self-heating of near-surface coal affected the ignition or resurgence of current coal fires near the Project Area (BLM 2000a).

Water levels are currently monitored at 28 sites along the coal outcrop, within and near the western portion of the SUIT Reservation. Measurements of water levels will identify areas that may be affected by increased occurrences of coal fires through continued or expanded gas and water production from the coals (BLM et al. 2000).

#### 3.4.2.9.2 *Concerns*

Fires in coal outcrops could be induced or exacerbated by CBM development, causing the loss of coal resources and creating aggregate (clinker) resources. Coal outcrop fires could start surface wildfires, and could lead to subsidence and landslides. It is not clear whether activities associated with CBM development have induced or exacerbated existing coal bed fires.

Dewatering of coal seams as part of CBM development may be linked to coal bed fires (BLM 2000a). Lowering the water table could draw ambient air into coal beds, supplying oxygen to support combustion. Fluctuating water levels in coal beds can trigger heating and supply oxygen that may cause spontaneous combustion (BLM 2000a).

#### 3.4.2.9.3 *Effects of CBM Development to Date*

It is unknown whether CBM production has played a significant role in inducing or exacerbating coal fires in the NSJB. Evidence from one coal fire indicates a possible linkage between dewatering of coal seams and a resurgence of coal fires (BLM 2000a).

## 3.4.3 Environmental Consequences

### 3.4.3.1 Landforms/Physical Landscapes

The impacts associated with landform disturbance are very minor and are discussed in more detail in the Visual Resources Section of this chapter.

### 3.4.3.2 Geology

Implementation of Alternative 1 and any other of the alternatives would alter naturally occurring outcrops and deposits whenever surface exposures are excavated. The stratigraphy, structure, and contacts between geologic units would not be affected, however.

## 3.4.3.3 Paleontological Resources

### 3.4.3.3.1 *Alternative 1 — Proposed Action*

CBM development could affect paleontological resources where associated excavation disturbs the geologic formations identified as fossil-containing strata. This disturbance would occur at or near outcrops of these formations. Little of the Project Area has been inventoried for the presence of paleontological resources. As a result, the number of paleontological sites that may be affected cannot be accurately estimated.

Paleontological resources contained in near-surface horizons of soil and surficial deposits likely already have been disturbed by natural processes or human activity. Surface use and shallow excavations likely would have little or no effect on paleontological resources that occur just below the surface.

As part of the APD approval process for federal leases, BLM, and the FS, require a survey of all areas where ground-disturbing activity is proposed when significant paleontological resources are known to occur. APD conditions of approval require protection and prompt reporting of paleontological resources that are discovered during the project. Operations must be suspended until the discovery is evaluated and mitigation measures implemented.

All facilities located on federal surface ownership lands would be considered federal undertakings, and thus would be subject to federal guidelines and regulations that protect paleontological resources. No federal permits are required for lands where oil or gas development excludes federal leases or surface ownership lands, however, and protection measures for paleontological resources might not be mandated by the landowners or be monitored as closely.

### 3.4.3.3.2 *Alternative 1A*

Impacts to paleontological resources would be similar to the effects described under Alternative 1. Under Alternative 1A, 13 fewer wells would be drilled from 62 fewer well pads (nearly 23 percent fewer) than under Alternative 1. This alternative also would reduce the required road mileage by about 24 miles compared with Alternative 1. Reduced development under Alternative 1A would reduce the overall potential for surface disturbing activities to affect paleontological resources.

### 3.4.3.3.3 *Alternative 1B*

Impacts to paleontological resources would be similar to the effects described under Alternative 1. Alternative 1B would require 65 fewer wells drilled from 115 fewer well pads (about 42 percent fewer) than Alternative 1. This alternative would reduce the new road mileage by about 56 miles, which is about 53 percent of the requirement for Alternative 1. Reduced development under Alternative 1B would reduce the overall potential for surface disturbing activities to affect paleontological resources.

#### 3.4.3.3.4 *Alternative 2*

Impacts to paleontological resources likely would be similar to the effects described under Alternative 1. Because more than 200 additional well pads (nearly half on private and state lands) would be developed under this alternative, it is likely that there would be a greater potential for paleontological resource damage during surface-disturbing activities. This alternative would increase road mileage by about 85 miles or about 72 percent, compared with Alternative 1.

#### 3.4.3.3.5 *Alternative 3*

Impacts to paleontological resources likely would be similar to the effects described under Alternative 1. Approximately 61 fewer well pads would be developed under this alternative. However, because the same number of wells would be developed on private and state lands, impacts to paleontological resources would be expected to be similar to Alternative 1. Impacts on federal land would be similar and low because effects to the resource would be mitigated by the protection measures described above.

#### 3.4.3.3.6 *Alternative 4*

Impacts to paleontological resources likely would be similar to the effects described under Alternative 1 with survey and mitigation requirements applied. Well development on private and state land would be the same as Alternative 1 and thus the potential for paleontological impacts on non-federal jurisdiction would remain the same. Survey and avoidance protocols on federal jurisdiction would protect paleontological resources.

#### 3.4.3.3.7 *Alternative 5 — No Action*

Under Alternative 5, additional development of federal leases would not be authorized at this time. Thus the potential for paleontological impacts on federal jurisdiction would be the lowest among the alternatives. Potential paleontological impacts on private and state land would be essentially the same as Alternatives 1 through 4.

### 3.4.3.4 Coal and Other Mineral Resources

#### 3.4.3.4.1 *Alternative 1 — Proposed Action*

CBM development is not expected to impact coal mining because no active coal mines operate in the Project Area. Conflicts between CBM drilling and potential coal mining could occur, although there are no known plans for future coal mining in the Project Area. Locating wells in areas where future mining may take place would preclude mining during the life of CBM wells located in the area proposed for mining. Coal in these areas could be mined after CBM extraction is completed or terminated, or after an agreement is negotiated between the CBM developers and the coal mine operators.

Development of non-CBM oil and gas resources likely would not noticeably affect CBM development nor would CBM development noticeably affect development of non-CBM oil and gas resources. Development of other producing zones would be compatible and may share some facilities, such as roads, pipelines, or utilities. Collateral use of some facilities would minimize surface disturbance and use of construction materials for both activities.

The NSJB contains reserves of other mineral resources. The most common in the Project Area are sand, gravel, and aggregate. These resources are also nonrenewable and can be exhausted. Development of CBM could interfere with the potential recovery of these other mineral resources. Development could remove an estimated 1 to 3 acres of land from mineable mineral reserves for each well that would be located within an area that could be surface mined. Mining likely could not occur near wellheads, injection wells, pipelines, or utilities without damaging oil or gas production facilities.

#### 3.4.3.4.2 *Alternatives 1A through 4*

Impacts to coal and other mineral resources would be similar to the effects described under Alternative 1.

#### 3.4.3.4.3 *Alternative 5 — No Action*

Drainage of federal CBM resources likely would be increased as a result of Alternative 5, where only new non-federal CBM wells likely would be drilled.

### 3.4.3.5 Landslides and Slope Stability

#### 3.4.3.5.1 *Alternative 1 — Proposed Action*

Surface disturbance could exacerbate existing landslides and cause new landslide hazards in the Project Area. Mass movements would likely increase within the Project Area, causing damage to resources and property unless disturbance to existing landslides and areas susceptible to movement, such as steep slopes or unstable soils, is avoided or mitigated during oil or gas development. Landslides could be activated during development; however, design of operations that incorporate best management practices and mitigation measures that minimize the risk of landslides would reduce the potential that landslides would increase within the Project Area.

All facilities located on federal surface ownership lands would be considered federal undertakings, subject to federal guidelines and regulations for environmental protection. No federal permits are required where development of CBM excludes federal leases or surface ownership lands, and protection measures for geologic hazards might not be mandated by the landowners or monitored as closely.

Most of the Alternative 1 facility construction disturbance would take place in areas of low topographical relief and, consequently, low risk of landslides. The areas where almost all of the landslides have been mapped are in the HD Mountains and on or near the steeply dipping Hogback monocline along the northern and northeastern boundary of the Project Area. The Hogback monocline along the northeastern boundary is also part of the HD Mountains.

Alternative 1 does not include well pads or access roads closer than 1 mile to the crest of the Hogback anticline within La Plata County. Because the dip of the sedimentary rock formations and the ground slope become less steep south of the crest, Alternative 1 would not increase the risk of human-induced landslides from road or well pad construction near the Hogback monocline within La Plata County. Well pads and access roads within Archuleta County are proposed as close as 0.3 miles from the steeply dipping Hogback monocline. Construction of these facilities would create some risk of triggering new or increasing the movement of existing landslides.

Within the HD Mountains, construction of well pads and access roads would increase the risk of human-induced landslides. Based on the preliminary location of proposed access roads, 15 miles of new roads would cross high landslide hazard areas. Additionally, 24 of the proposed well pads would require cut and fill construction in areas of high landslide hazard.

The most effective mitigation measure for construction on unstable slopes is avoidance. Modifications of the preliminary proposed road and well pad locations would allow avoidance of some landslide areas and potentially unstable slopes. However, the limitations imposed by grade requirements and other design criteria will likely result in less than full avoidance, with additional landslides and potentially unstable slopes being affected by construction and probably some subsequent slope failures. The extent of increased landslide activity is impossible to predict precisely. However, the proposed miles of new road construction in areas of high hazard is a good numerical indicator for comparison of alternatives.

Extensive field investigation and design can support stable road construction across most slopes within the HD Mountains. Where increased movement of existing landslides and initiation of some new landslides occur, the consequences would include visible scars on hillsides, disturbance of vegetation, erosion, and potential damage to roads, pipelines, and well pads.

#### 3.4.3.5.2 *Alternative 1A*

Impacts to landslides and slope stability would be similar to the effects described under Alternative 1. About 24 fewer miles of road (about one-third less) and 62 fewer well pads would be constructed than under Alternative 1. Construction of fewer well pads or less miles of new roads would reduce the potential for landslides to occur in areas of high landslide hazard, where slopes exceed 30 percent in the Animas Formation or 40 percent in the San Jose Formation. Alternative 1A would involve constructing 5 fewer well pads in areas of high landslide hazard than under Alternative 1. About 2 less miles of road would be constructed where slopes in the Animas Formation exceed 30 percent or slopes in the San Jose Formation exceed 40 percent than under Alternative 1. Overall, Alternative 1A would reduce the overall potential for surface disturbing activities to cause a slope failure when compared to Alternative 1.

#### 3.4.3.5.3 *Alternative 1B*

Alternative 1B would involve construction 65 fewer wells from 115 fewer well pads (about 42 percent fewer) than under Alternative 1 and about 56 fewer miles of road (nearly 60 percent less) than under Alternative 1.. Alternative 1B would involve constructing 8 fewer well pads in areas of high landslide hazard than Alternative 1. Alternative 1B would also involve constructing about 5 fewer miles of road where slopes in the Animas Formation exceed 30 percent and 4.3 fewer miles on slopes in the San Jose Formation that exceed 40 percent than Alternative 1. Reduced development under Alternative 1B would reduce the overall potential for surface-disturbing activities to cause a slope failure.

#### 3.4.3.5.4 *Alternative 2*

Alternative 2 would involve constructing, 85 more miles of new access roads and 226 more well pads than Alternative 1. About 66 well pads would be located in areas of high landslide hazard, compared with 21 well pads in these areas of high hazard under Alternative 1. Because most of the additional proposed wells are located near the steeply dipping Hogback monocline or in the HD Mountains where the landslide hazard is greater, the potential extent and magnitude landslides and associated damage would be greater than Alternative 1. Alternative 2 would result in at least 25 miles of new road crossing areas of high landslide hazard.

#### 3.4.3.5.5 *Alternative 3*

Compared to Alternative 1, Alternative 3 would construct 40 fewer miles of new roads and at least 61 fewer well pads. A total of 17 well pads would be located in areas of high landslide hazard, compared with 21 well pads in areas of high hazard under Alternative 1. Because wells would be eliminated in the HD Mountains, the extent and magnitude of the environmental consequences would be less than Alternative 1. There would be 9 miles of access roads constructed across areas of high landslide hazard compared to 11 miles under Alternative 1.

#### 3.4.3.5.6 *Alternative 4*

Alternative 4 would involve constructing 27 fewer miles of new roads and 88 fewer well pads than Alternative 1. However, because of location differences Alternative 4 would involve constructing about 25 well pads in areas of high landslide hazard, compared with 21 well pads constructed in areas of high hazard under Alternative 1. A total of 9 miles of access road would be constructed across high landslide hazard as compared to 11 miles across high hazard areas under Alternative 1.

#### 3.4.3.5.7 *Alternative 5 — No Action*

Alternative 5 would involve constructing 79 fewer miles of new roads at least 156 fewer well pads than Alternative 1. Nine well pads would be located in areas of high landslide hazard, compared with 21 well pads in these areas of high hazard under Alternative 1. Because many of the wells that would be eliminated would have been located in the HD Mountains, the extent and magnitude of the environmental consequences would be much less than under Alternative 1. Five miles of access roads across would be constructed in areas of high landslide hazard as compared with 11 miles across high hazard areas under Alternative 1.

### 3.4.3.6 Subsurface Geologic Stability and Water Injection

#### 3.4.3.6.1 *All Alternatives*

No excessive buildup of pressure within rocks or fracturing of rocks would be anticipated to result from produced water injection. Therefore, no underground injection triggered earthquakes would be expected. Underground injection is and would be conducted in accordance with federal and state regulatory requirements. Injection wells would be authorized only where the injection zone is sufficiently porous and permeable that fluids could enter the rock formation without causing an excessive buildup of pressure or fracturing of rocks.

## 3.4.3.7 Subsurface Geologic Stability and Water Removal

### 3.4.3.7.1 *All Alternatives*

Removal of water from the Fruitland coal seam would not be likely to cause noticeable ground subsidence or aquifer compression in the Project Area under any of the alternatives. Water would be extracted from the Fruitland Formation, which is a consolidated rock unit and, therefore, would not be susceptible to noticeable subsidence.

## 3.4.3.8 Subsurface Geologic Stability and Hydraulic Fracturing and Cavitation

Hydraulic fracturing and cavitation must maintain the integrity of the coal and surrounding formations to be effective. In addition, COGCC and BLM require conduct of these procedures in a manner that maintains the integrity of the formations. For these reasons, the stability of the subsurface geology would not be affected by any of the alternatives.

## 3.4.3.9 Coal Fires

### 3.4.3.9.1 *All Alternatives*

Partial removal of water from the coal seam near the coal outcrop during CBM development depressurizes the coal seam and could create a condition where oxygen replaces water in the coal seam and increases the risk of spontaneous combustion. The risk of underground coal fires would be limited to the area where oxygen is available to sustain coal fires. Oxygen would be introduced to the shallow subsurface environment through conduits to the surface, such as wellbores or naturally occurring fractures. Water pumped from the Fruitland coals miles away from the outcrop would affect the water levels and, consequently, the risk of coal fires near the outcrop. However, unless enough oxygen is able to reach the dewatered coals to sustain combustion, underground coal fires would not occur. The conditions affecting the availability of oxygen near the outcrop would not be expected to vary among the alternatives, provided proper well drilling and operation procedures are followed.

The risk of coal fires near the coal outcrop would be influenced by the extent and frequency of fractures or fissures that extend from the underground coal seams to the surface. In the NSJB these conduits likely would be most prevalent in areas near the outcrop where methane seepage is the greatest, as shown on Figure 3–3

There is a natural limit to the depth and distance from the outcrop at which underground coal fires can be sustained. This limit is based on the availability of oxygen underground to sustain the combustion of coals. Although this natural limit has not been described in the NSJB, the limits of coal fires away from the outcrop have been studied in other western coal basins.

Clinker and coal fires in the Powder River Basin in Wyoming have been studied by Heffern and Coates 1997, Coates and Heffern 1999, and Heffern and Coates 1999. As coal burns, the burn front advances into the hillside until, with increasing depth, fissures in deposits that overlie the coal fail to reach the surface. At that point, the supply of air to the coal is cut off, extinguishing the fire. Clinker can be found at depth by drilling as far as several hundred feet back from where it is apparent at the surface.

The risk of coal fires near the coal outcrop also could be proportional to the number of proposed wells that would be drilled near the outcrop. Drilling a conduit to the coal seam could increase the availability of oxygen. However, the conditions established and maintained in CBM wells during drilling and after completion to meet health and safety requirements and to optimize gas production also create unfavorable conditions for spontaneous combustion of coal. Wellbore conditions are controlled to ensure air flow out of the well, to flush fines from the well, and to vent heat at the surface. Although the potential for coal fires could be increased by wells drilled near the outcrop, this potential risk would be mitigated by proper operation of the wells.

## 3.4.4 Cumulative Effects

The cumulative effects analysis for geology and minerals considered past and reasonably foreseeable actions in the Project Area and within the bounds of the Southern Ute Reservation where oil and gas development has and will take place.

### 3.4.4.1.1 *All Alternatives*

The characteristic landforms of the surface geologic environment would be altered by reasonably foreseeable surface disturbing activities. The cumulative effects on the surface geologic environment would be minimized if proper techniques for well pad and facility siting, construction, and reclamation are used. Development projects would require restoration of disturbed lands and would minimize alterations to topography. Standard stipulations and project- and site-specific construction and reclamation procedures would be required for additional development on federal lands. These measures would further minimize cumulative impacts on the surface geologic environment, including existing landslide deposits and areas with high landslide risk. Although reasonably foreseeable actions would be unlikely to trigger geologic hazards such as landslides, mudslides, debris flows, or slumps, an incremental increase in cumulative impacts associated with geologic hazards could occur.

Paleontological resources are non-renewable resources that can become exhausted. Although fossils are rarely one-of-a-kind, a limited number of specimens are preserved in any geologic formation and these cannot be used for scientific study, if damaged, destroyed, or removed without proper scientific documentation. The BLM, FS, and SUIT have applied mitigation measures to surface disturbing activities in the cumulative effects analysis area that would protect paleontological resources and the scientific values they contain. Cumulatively, anticipated development activities would not be expected to noticeably affect paleontological resources, provided the mitigation measures identified are implemented.

Across the cumulative effects area, slope stability concerns are as described for the Project Area. Wherever steep slopes and highly erosive soils are encountered, reasonably foreseeable future actions, such as CBM development, vegetation management, livestock grazing, wildfires, and prescribed burning, could cause an increase in slope failures and associated sedimentation and erosion. The probability of slope failures occurring outside the Project Area is unknown, but operators developing Southern Ute leases generally utilize the same engineering standards and mitigation approaches described below to minimize slope failures. The same holds true for construction practices on private and state land. However, through not quantifiable, even if projects are well engineered and mitigation measures described earlier in this chapter are implemented, potentially unstable slopes subjected to the removal of vegetation or facility construction of drill pads, roads, or other facilities could fail. Unplanned actions such as wildfires, prolonged wet periods, or large storms could destroy vegetation or introduce excessive precipitation that would trigger slope movement.

Development of non-CBM oil and gas resources likely would not noticeably affect CBM development in the cumulative effects analysis area. Similarly, CBM development would not noticeably affect development of non-CBM oil and gas resources. These development activities would be compatible, and may share some facilities, such as roads, pipelines, or utilities. Collateral use of some facilities would minimize surface disturbance and the use of construction materials for both activities.

## 3.4.5 Mitigation and Monitoring

Several measures are presented to mitigate paleontological impacts, landslides, and slope stability concerns. Unless otherwise stated, the measures will be funded by the Companies.

The impacts to paleontological resources would be mitigated on federal lands by measures incorporated in the APD conditions of approval that require protection and prompt reporting of paleontological resources that are discovered during the project. Operations must be suspended until the discovery is evaluated and mitigation measures are implemented.

It is unlikely that CBM wells would be located on an area with mineable sand, gravel, and aggregate resources. However, avoiding the areas where these mineable deposits occur would mitigate potential impacts to these other mineral resources.

Measures to mitigate effects of the alternatives on landslides and slope stability include:

- Utilize engineering geologists or geotechnical engineers to conduct geotechnical engineering investigations for any facilities, including existing roads, proposed new roads, and well pads that require construction or reconstruction in or near areas that meet the criteria for high landslide hazard, or exhibit other instability features.

- Where possible, avoid landslides, unstable slopes, and other areas that exhibit instability features or meet the criteria for high landslide hazard during facility location, including well pads and roads.
- Where avoidance is not possible, the geotechnical engineer shall design stabilization measures to be approved by the appropriate agency and incorporated in construction or reconstruction plans. Possible stabilization measures include, but are not limited to, subsurface drainage, retaining walls, and soil reinforcement.

## 3.4.6 Conformance to Existing Plans and Policies

Management standards and guidelines that address the issues presented and discussed in this section are described in the SJNF LRMP, Forest Direction for protection of soils, watershed, and visual quality. Adherence to professional engineering standards and geo-technical engineering design requirements, best management practices, and standards and guidelines for visual management will protect the geologic resources of the area and minimize erosion, mass wasting, and landslides that may scar the landscape and lead to other environmental impacts.

Paleontological resources will be protected by pre-construction surveys where there are known or stratified high probabilities for their occurrence.

## 3.4.7 Unavoidable Adverse Effects

The surface impacts associated with facility development would be an unavoidable adverse effect that would persist during the life of the project.

## 3.4.8 Irreversible and Irretrievable Effects

The extraction of mineral and energy resource commodities represents an irreversible and irretrievable commitment of the resources to development. As nonrenewable resources, once developed, the resources are consumed.

The surface disturbance associated with mineral and energy resource development or other reasonably foreseeable development activities could alter or destroy existing landforms. Some landforms may not be completely restored during reclamation. The alteration or loss of these features would be an irreversible and irretrievable commitment of the surface geologic environment.

The surface disturbance associated with the development of mineral and energy resources would commit the lands affected to a single purpose use for the life of the project, until existing uses, such as livestock forage or wildlife habitat and resource values, such as scenic quality, are restored during reclamation. Partial reclamation would be completed after construction activities and permanent reclamation would proceed at the end of the project. In some cases, prior soil productivity would not fully recover at some sites, representing an irretrievable commitment of resources. Soil productivity, would only recover over a long period after development ends.

# 3.5 Groundwater Resources

The hydrogeologic framework of the Project Area is made up of large areas of low-yield aquifers throughout the region, with minor areas of higher-yield alluvial fill aquifers in the valley floors of the major rivers.

Deeper geologic formations are also aquifers, but have limited utility because of low yields, poor water quality, and uneconomic drilling depths. The following section describes the hydrostratigraphy in greater detail

## 3.5.1 Hydrostratigraphy

Groundwater occurs in all geologic formations within the Project Area. Table 3–7 summarizes the hydrostratigraphy in the Project Area.

**Alluvial Aquifers** – Alluvial deposits are not extensive within the Project Area; however, these aquifers are important to the groundwater cycle within the SJB. Quaternary and recent alluvial deposits consist of floodplain or terrace deposits.

Typically, these unconsolidated gravelly deposits are characterized by a thin saturated layer and are highly dependent on recharge from natural sources and return flows from irrigation. The groundwater resources that are contained in alluvial aquifers are under unconfined or water table conditions.

The alluvial aquifers consist of river valley aquifers and the Florida Mesa aquifers in densely populated southeast La Plata County. River valley aquifers consist of shallow, loose gravels and sands near rivers and streams and usually have a good sustained yield because of regular recharge from rivers. The Florida Mesa aquifers consist of thick gravel deposits situated over a large area.

Well yields from floodplain alluvial deposits typically range from 1 to 10 gpm in the La Plata and Animas River valleys. Deposits are thicker and the yields higher, ranging from 5 to 25 gpm, in the Piedra and Pine River valleys (Brogden et al. 1979). Terrace deposits are characteristically only partially saturated and well yields are generally 10 gpm or less; however, yields of 50 gpm have been reported (Brogden et al. 1979; Robson and Wright 1995). Currently, no known landslide or eolian deposits are used as sources of water (Kernodle 1996).

**Bedrock Aquifers** – Bedrock aquifers in the SJB are within the Colorado Plateau aquifer system described by Robson and Banta (1995). Three major aquifers could be affected by CBM development. From shallowest to deepest, these aquifers are the Uinta-Animas, Mesaverde, and Dakota-Glen Canyon. The Uinta-Animas aquifer includes Tertiary units within the San Jose, Nacimiento, and Animas Formations. The Mesaverde aquifer includes Upper Cretaceous units within the Mesaverde Group. The Dakota-Glen Canyon aquifer includes Cretaceous and Jurassic units within the Dakota Sandstone, Burro Canyon Formation, Morrison Formation, Wanakah Formation, and Entrada Sandstone.

## Table 3–7 Hydrologic Characteristics of Developed Aquifer Units in the Northern San Juan Basin

| Age | Unit | Thickness (feet) | Physical Character | Hydrologic Characteristics | Water Quantity and Water Use |
|---|---|---|---|---|---|
| Quaternary | Floodplain Deposits | 50 | Unconsolidated clay, silt, sand, gravel, and boulders. Generally poorly sorted and confined to present day stream valleys. Includes low- level terraces, alluvial fans, and eolian material. | Hydraulic conductivity: ~ 0.006 to 220 ft/d,<br>Typical Porosity: ~ 20-35%,<br>Specific yield: ~ 0.1 to 0.25. | Average well yield is 15 gpm with maximum yield of 25 gpm reported. Water is generally used for domestic and livestock purposes and, where suitable, for drinking water. |
|  | Terrace Deposits | 100 | Clay, silt, gravel, and boulders. Sediments are poorly sorted, with coarser materials being well rounded. Includes higher-level stream valleys and terraces, eolian materials, and remnants of alluvial fans. | Hydraulic conductivity: ~ 0.006 to 220 ft/d,<br>Typical Porosity: ~ 20-35%,<br>Specific yield: ~ 0.1 to 0.25. | Average well yield ranges from 5 to 10 gpm with maximum yield of up to 50 gpm reported. Water is generally used for domestic and livestock purposes. |
| Tertiary | San Jose Formation | 250–2400 | Interbedded sandstone, siltstone, variegated shale and conglomerate. Sandstones are arkosic and massive and are interbedded with red, maroon, and gray shales. | Transmissivity: 40 to 120 ft2/d,<br>Hydraulic conductivity: < 10-3 ft/d,<br>Typical Porosity: ~ 3-30%. | Well yields range from 5 to 61 gpm with an average yield of 5 gpm. Water is generally used for domestic and livestock purposes, with a few natural gas compression and transmission plants using the water. |
|  | Nacimiento Formation | 0–50 | Sandstone and shale. Sandstones are arkosic, white, medium to coarse grained, and are interbedded with black and gray shale. Note: Formation grades laterally into the Animas | No Data | No known wells within the Project Area |
| Upper Cretaceous | Animas Formation | 230–2700 | Varicolored shale, with interbedded breccia, conglomerate, and tuffaceous sandstone. Diagnostic characteristic is the macroscopic volcanics. The sandstone varies from light to rusty brown to purple, and contains abundant silicified wood and clay balls. | Transmissivity: ~40 to 120 ft2/d,<br>Hydraulic conductivity: < 10-3 ft/d,<br>Typical Porosity: ~ 3-30%,<br>Specific Capacity: 0.24 to 2.30 gpm/ft drawdown.<br>Note: Artesian wells are present in areas where sandstones are overlain by impermeable shales. | Well yields range up to 75 gpm (50 gpm near Durango) with an average yield of 6 to 7.5 gpm. Water is generally used for domestic and livestock purposes. |

Tertiary aquifers typically consist of sandstone interbedded with shale units and are exposed at the land surface, or are overlain and potentially hydraulically connected to alluvial aquifers. Potable water from bedrock aquifers in the Project Area is most commonly found in the San Jose, Nacimiento, and Animas Formations.

The Animas Formation is the best Tertiary aquifer in the area, with well yields of 50 gpm near Durango and 75 gpm in the southern portion of the Project Area. The mean yield for wells completed in the Animas Formation is between 6 and 7.5 gpm. Water yields from the San Jose Formation have been found to vary between 15 and 61 gpm, with a mean yield of 5 gpm (Kernodle 1996).

Usable water is commonly present in a number of formations near the margins of the basin where older formations occur at shallower depths, closer to areas recharged with fresh water. Cretaceous-age formations that contain usable water near the margins of the SJB include the Farmington Sandstone member of the Kirtland Shale, the Fruitland Formation, the Pictured Cliffs Sandstone, formations of the Mesaverde Group, including the Cliff House Sandstone and the Point Lookout Sandstone, and the Dakota Sandstone.

Thick confining units that are almost impermeable and generally do not yield water include the Mancos Shale and the Lewis Shale, although isolated siltstones and sandstones in these formations have been found to produce small amounts of water locally. Thinner confining units that consist of shale that is slightly more permeable, as well as coal and thin sandstone beds, are present in the Menefee Formation, Fruitland Formation, and the lower and upper shale members of the Kirtland Shale. Unusable water is present in deep sandstones within the basin (Kernodle 1996, AHA 2000, Questa 2000, BLM et al. 2000).

In general, the water supply from Cretaceous and older aquifers is minimal (less than 5 gpm), although moderate quantities (5 to 25 gpm) may be supplied from aquifers within the Menefee Formation, Mancos Shale, Dakota Sandstone, Burro Canyon Formation, and Morrison Formation (Aikin et al. 2000). The Cretaceous aquifers are typically under confining conditions as a result of the presence of thick impermeable units that overlie and underlie the aquifers.

**Fruitland Formation** – The Fruitland Formation is a regional aquifer with low water yields (Cox et al. 2001). This aquifer is regionally interconnected despite the presence of fracturing and stratigraphy that are not continuous. The Fruitland Formation is not classified as a principal aquifer within the SJB (Robson and Banta 1995).

The most widely exploited aquifers in the Project Area are the shallow sandstone units of the Animas Formation, the San Jose Formation, and the Quaternary Alluvium deposits. The bedrock aquifers are low-yield, low-transmissivity units that typically supply 0.5 to 5 gallons per minute to domestic wells. Useable amounts of groundwater occur in the channel-fill sands of the San Jose and the Animas Formations, with lesser volumes produced from the mudstones surrounding these sandstone bodies. The sandstones are confined.

The alluvial fill aquifers are associated with the major river valleys that cross the Project Area, and on the Florida Mesa. These aquifers are unconfined and typically supply 10 to 25 gpm to water wells. Alluvial fill in the river valleys varies greatly in thickness, with some well logs showing less than 8 feet to more than 90 feet of unconsolidated gravel, cobbles, and boulders overlying the bedrock. The Florida Mesa is covered by unconsolidated sand, gravel, and cobbles, and this aquifer is also unconfined. Use of groundwater from the alluvial fill aquifers and the shallow bedrock aquifers is increasing in La Plata County. Changes in land uses in the county have trended toward a higher density of domestic wells and a gradual shift from agricultural to rural residential. Because agriculture in the Project Area was a primary source of groundwater recharge through irrigation returns, the reduction in agriculture use directly reduces the recharge to shallow aquifers. Increasing the density of domestic wells also increases the withdrawals from these shallow aquifers. As demand for groundwater rises and recharge diminishes, the aquifers in La Plata County will be gradually depleted. These depletions are not associated with CBM development, however. Figure 3–15 illustrates the density of shallow domestic water wells in the Project Area.

As is evident from Figure 3–15, the number of domestic wells in La Plata County is growing at a fast rate. The number of permits issued in the Project Area has averaged more than 300 per year for the past 10 years. The resulting additional stress on the shallow groundwater resources will accelerate depletion of shallow aquifers.

The deeper geologic formations that are considered aquifers include the Fruitland Formation and Pictured Cliffs Sandstone, the Point Lookout and Cliff House sandstones of the Mesaverde Group, and the Dakota Sandstone. Of these, the Fruitland Formation and Pictured Cliffs Sandstone is the only aquifer that is exploited for groundwater in the Project Area. These two formations form a single hydrostratigraphic unit, confined above by the Kirtland Shale and below by the Lewis Shale. The Pictured Cliffs Sandstone is interconnected in some areas with the Fruitland Formation; therefore, they can be considered a single aquifer. In some areas, the Fruitland Formation appears to be hydraulically isolated from the Pictured Cliffs Sandstone, either through an intervening shale layer, or because the permeability in the Pictured Cliffs is so low that the majority of groundwater flow is conducted through the higher-permeability Fruitland Formation.

## 3.5.2 Hydrogeology of Fruitland Formation

The Fruitland Formation and Pictured Cliffs Sandstone are unconfined at the outcrop, where they are recharged. The aquifer is confined several hundred meters downdip and throughout the San Juan Basin, where the overlying Kirtland Shale acts as an aquitard. In several areas, water wells drilled just off the outcrop through less than 100 feet of Kirtland Shale are artesian, meaning that less than 100 feet of shale provides an effective seal over the aquifer in the Fruitland Formation.

As discussed in the section on methane seepage, the Kirtland Shale is an effective confining unit, which seals the Fruitland Formation from overlying shallow aquifers.

Flow of groundwater in the Fruitland Formation occurs primarily in the higher-permeability coal beds. Although coal beds are not laterally continuous across the entire Project Area, they are sufficiently interconnected to allow the Fruitland Formation to act as a single aquifer system. Flow within the Pictured Cliffs Sandstone appears to occur in fracture zones and in some areas of higher primary permeability.

The following is a summary of literature on the Fruitland Formation hydrogeology:

McCord et al. (1992) interpreted higher temperature gradients in the Fruitland Formation to indicate that advection is transporting heat from the northern rim of the basin to the deeper basin. This heat transport was interpreted based on temperature logs from numerous wells. The temperature gradient increased across the Fruitland Formation in all the wells. The source of heat was interpreted to be the igneous intrusions of the San Juan Mountains, north of the basin. McCord (1988) also produced a potentiometric surface map of the Fruitland Formation in Colorado (Figure 3–16).

Other workers, including Fassett and Hinds (1971), have interpreted the heat of the San Juan intrusive complex to be the cause of higher thermal maturity in coals from the Fruitland Formation in the northernmost San Juan Basin. The thermal maturity cannot be explained solely by the burial depth of the coals; therefore, an additional source of heat was required to explain the high thermal maturity.

Berry (1957 and 1959) provided a basin-wide potentiometric surface map of the Fruitland Formation, along with general flow patterns of groundwater. His map is based on hundreds of pressure measurements in the Fruitland Formation, collected before any CBM development began (Figure 3–17). The Gas Research Institute (1990) published a potentiometric map of the Fruitland Formation that shows a similar pattern of potentiometric contours when compared with the work of Berry, McCord, and others (Figure 3–18).

Kernodle et al. (1990) also interpreted the Fruitland Formation as a regional aquifer, with flow fed by recharge at the outcrop and discharge occurring at river cuts along the rim of the basin.

Oldaker (1987 and 1991) published potentiometric contour maps of the Fruitland Formation and interpreted a similar pattern in the potentiometric contours when compared with McCord, Berry, and others. Oldaker's interpreted flow patterns are consistent with McCord et al. (1992), Berry (1957 and 1959), GRI (1990), and others.

CGS published an open file report in 1980 that illustrated the coal content as a percent of the total thickness in the Fruitland Formation. The coal content exceeds 20 percent of the gross thickness of the Fruitland Formation in large portions of the Northern San Juan Basin. Fogg (1986, 1987, and 1990) illustrated that formations with more than 20 percent sand body content act as a single flow system, with cross-communication among many of the stratigraphically separate sand bodies. The coals in the Fruitland Formation are higher-permeability units and likely act similar to the sand bodies in Fogg's work (1986, 1987, and 1990), transporting fluid in a similar manner. The 20 percent aggregate thickness of higher-permeability material seems a reasonable cutoff for most aquifer and hydrocarbon systems.

In 1999, COGCC, BLM, and the Southern Ute Indian Tribe commissioned the 3M Project. This study was focused on evaluating the impacts of CBM development on methane seepage at the outcrop of the Fruitland Formation. As part of the study, CGS published a series of cross sections that illustrated the continuity of many coal beds across several miles of the basin. These cross sections, coupled with previous work by CGS, illustrate the overall regional hydraulic continuity of the Fruitland coals.

Further evidence of hydraulic continuity can be extracted from a report by Burlington Resources. Burlington Resources recently completed a comprehensive survey of stratigraphic picks on 46 correlatable tops from the major formations and time stratigraphic markers found in the SJB. This project involved more than 2 years of work and was completed by Geological Data Services of Dallas, Texas.

About 20,000 wellbores are included in this data set, encompassing 240 townships. Included in the report is documentation of any subsurface faulting found during the study. Faults were identified by checking anomalies shown on a complete series of isopach and structural maps generated with tops from the well data file.

Of this extremely large data set, only 127 wells out of 20,000 scattered across the basin showed any evidence of fault displacement in the Cretaceous sections. Almost all of these faults can be found within a 46-township area in the northwest and a 68-township area in the southeast of the basin. The southeastern block, which contains the majority of the faults, averages about 1.5 faults per township. The northwestern block that contains the Valencia Canyon area averages only 1 fault for every two townships.

This study effectively eliminates a dense network of small-scale sealing faults that compartmentalize the reservoir. Instead, it indicates that coal beds remain interconnected and capable of actively transporting groundwater.

As summarized above, a large body of peer-reviewed published literature supports the conclusion that the Fruitland Formation is a regional confined aquifer system.

## 3.5.3 Other Supporting Information

### 3.5.3.1 Bulk chemistry — Major Ions

Chlorine, bicarbonate, and other major ions exhibit a consistent pattern in the groundwater from the Fruitland Formation, with lower concentrations near the recharge areas and progressively higher concentrations in the deeper basin. This gradient in concentration is consistent with Toth's (1972) explanation of the geochemical evolution of groundwater:

- Contents of dissolved minerals are known to increase with the water's subsurface residence time. Consequently, the mineral content of groundwater is expected to be relatively low at shallow depths of the recharge areas and in short, active systems.
- Conversely, TDS will be high at great depths in discharge areas and in extensive, sluggish systems.

Other studies support this basic underpinning of hydrogeochemistry, including Garrels (1960) and many others.

Mapping of the bulk chemistry of groundwater from the Fruitland Formation illustrates that several near-outcrop regions of low TDS are likely to be much younger groundwater. The deeper basin water contains much higher TDS, and thus older, groundwater (Figure 3–19).

USGS has shown a region of groundwater from the Fruitland Formation that is high in TDS and feeds the alluvial fill aquifer as the San Juan River crosses the Fruitland subcrop in New Mexico. The work of others, including the 3M Model, GRI (1990), McCord et al. (1992), Scott (2000), and Berry (1959), indicate that the groundwater from the deep basin of the Fruitland Formation discharges at the San Juan River; thus, the occurrence of water high in TDS at the Fruitland subcrop is consistent with the overall interpretations by these workers.

### 3.5.3.2 Stable Isotopes — Oxygen and Hydrogen and Paleoclimates: Evidence of Groundwater Age

The stable isotopes of oxygen and hydrogen can be used to identify the origin of groundwater. Their position relative to the Global Meteoric Water Line (GMWL) can identify the source of the water molecules when the ratios of the oxygen and hydrogen stable isotopes (18O and 16O and H and 2H or deuterium) are plotted. If the data plot near the GMWL, then it can be concluded that the water fell as precipitation and eventually infiltrated into the aquifer system, where it has been ever since. If the data plot well off the GMWL, it can be concluded that there have been significant evaporative effects before infiltration, or that there have been some high-temperature water-rock interactions, or mixing with connate waters that were deposited with the sediments.

More than 100 samples of produced water were analyzed for their stable isotope ratios. The results for all but five samples plot close to the GMWL (Figure 3–20). This finding indicates that the majority of groundwater from the Fruitland Formation is meteoric, with no mixing of brackish connate water, seawater, and no significant diagenetic interactions. Although the stable isotopes do not provide an age date of the groundwater, the distribution of the stable isotope ratios in the groundwater from the Fruitland Formation can be tied to the past climate of the Project Area. First, there is a region of low (isotopically light) water that lies up to 5 miles off the Indian Creek recharge area, and another area of isotopically light water that appears to be migrating subparallel with the Pine River drainage (Figure 3–21). The light water could have fallen at some point in the geologic past when the climate was significantly cooler than today. During the most recent glaciation, the glaciers receded from the Project Area around 10,000 years before present (ybp). Global stable isotope transfer functions from Schwarz and Domenico and Schwarz (1990) indicate that mean average temperature was 1.5° C when the isotopically lightest water fell as precipitation. Today's mean average temperature in the Durango area is 7.7° C.

The 3M MODFLOW simulations predict a 10,000 year travel time from the recharge areas on the outcrop to the same areas of the Fruitland Formation where the isotopically light waters are found. This agreement indicates that the MODFLOW simulations are accurate when used to depict velocities of groundwater flow through the Fruitland coal beds.

The isotopically heavy groundwater within the deep basin is also meteoric (Figure 3–20 and Figure 3–21). However, the ages of this water could range from 100,000 years to more than 1,000,000 years. At present, the only reliable method of age dating the groundwater in the deep basin is to use inferred age dates from the 3M MODFLOW studies. Many uncertainties are associated with radioisotope age dates and are unreliable at this time, as discussed below.

### 3.5.3.3 Helium Age Dates

Zhou et al. (2002) published groundwater age dates from samples of noble gas collected from the gas streams of producing CBM wells in New Mexico. The estimated groundwater age dates, based on He-4, range from 3 million years before present (Ma) to 14 Ma, significantly lower than the I-129 age dates from the same area. Zhou et al. (2003) revised the age dates, accounting for the crustal flux of He-4. Revised age dates range between 1,900 to 100,000 years in the overpressured region of Zhou's study area and between 7,200 and 39,000 years in the underpressured region.

The He-4 age dates for most of the samples were less than 10,000 years. However, these authors caution that the "dominant uncertainty used to derive the groundwater He-4 dates is in the assumption of an average crustal external He-4 flux into the aquifer system. Although the absolute dates are currently subject to significant uncertainty, the relative He-4 dates obtained will be reasonable."

The helium age dates display a systematic aging of the groundwater as it moves from recharge areas to the deeper basin in the underpressured portion of the basin. In the "fairway" or the high production, overpressured areas to the north, the groundwater age dates are almost uniform.

Others (Sorek and Sanford 2002) have postulated a He-4 age date of 29 Ma in produced water from the Fruitland Formation. Given the orders of magnitude differences between various workers for He-4 age dates from produced water from the Fruitland Formation, none can be reliably used to calculate the ages of groundwater from the Fruitland Formation.

### 3.5.3.4 Tritium Age Dates

In 2000, BLM collected and analyzed six samples of produced water for tritium activity. Tritium is a radioactive isotope of hydrogen that is produced when atomic weapons explode. Large quantities of tritium were injected into the atmosphere in the 1950s and 1960s when the U.S., Soviet Union, and France were conducting extensive aboveground testing of thermonuculear weapons. With a short half-life of 12.3 years, tritium can provide a signal only for groundwater that is on the order of 30 to 60 years old (rain and snow that fell from the 1950s through the 1980s). Younger water does not contain sufficient tritium for age dating because atmospheric testing of thermonuclear weapons ceased in the 1960s.

The Southern Ute well 12U-2, located in the Indian Creek area, contained 134 (+/- 5) Tritium Units (TU), indicating that the water produced by this well was approximately 45 years old and has been isolated from the atmosphere since that time. The Southern Ute well 12U-2 is approximately 0.75 mile basinward of the recharge area, and groundwater flow velocity can be accurately estimated from this relationship. A flow velocity of 88 feet/year was calculated (0.073 meters/day) from these values.

Tritium results for the other wells, and the sample from the Pine River, all show no TUs (Table 3–8). Therefore, the water is either too old for tritium age dating, or is too young and does not contain a tritium signature.

**Table 3–8 Results for Analysis of Tritium**

| Well Name | Location | Tritium Units[1] |
|---|---|---|
| Federal/SPC 2-14 | Sect 14 35N 8W | <1 |
| BP Richardson Fed F 1 | Sect 2 34N 8W | <1 |
| BP Dulin D 1 | Sect 26 35N 7W | <1 |
| BP Evelyn Payne A 1 | Sect 32 35N 6W | <1 |
| So Ute 21-1 | Sect 21U 33N 11W | <1 |
| Indian Creek 12U-2 | Sect 12U 34N 10W | 134 +/- 5 |
| Pine River[2] | Near Dulin D 1 | <1 |

Notes:
1. All samples collected during March 2000.
2. Surface water sample.

## 3.5.3.5 I–129 Age Dates

I–129 is a radioisotope that can be used for age dating rocks and, in some cases, pore waters. The majority of peer-reviewed published literature recognizes that I–129 does not provide a valid age date for groundwater because groundwater leaches iodine as it flows through the formations (Fabryka-Martin et al. 1991, Fabryka-Martin 2000; Fehn et al. 1992).

Further confounding the use of I-129 age dates is the addition of fissiogenic I-129 from the decay of U-238. Where uranium may be concentrated in the subsurface, a very high level of I-129 may be present, leading to artificially younger dates. Conversely, the groundwater may be leaching iodine from the rock where it does not encounter these uranium deposits along the flow paths.

In one study, I-129 age dates in water were used to calculate the age of the formation groundwater was flowing through (60 to 80 Ma); however, the residence times of the groundwater were determined to be 80,000 years. This study, and others, illustrates the shortcomings in concluding groundwater ages from I-129 age dates.

Furthermore, the use of I-129 age dates conflicts with the He-4 ages of Zhou et al. (2002) and the temperature profiles of McCord et al. (1992), as well as the thousands of pressure, permeability, and production data points analyzed in the 3M Study.

A contour plot of the I-129 age dates (Figure 3–22) illustrates the contradiction between the I-129 age dates when compared with the TDS contour plot (Figure 3–19), stable isotope contour plots (Figure 3–21), groundwater flow paths (Figure 3–23 and Figure 3–24), and other data that have been constrained by or complement the physical data from the Fruitland Formation (pressure, temperature, production data, and well logs).

The conceptual model proposed by BP calls for a stagnant system in the Fruitland Formation, with connate waters trapped in the coal beds since they were deposited in the Late Cretaceous. The pressure regime in the Fruitland Formation was explained by the introduction of recharge water during the Eocene, 30 to 35 Ma, during the San Juan uplift. Shortly after this water was introduced, all flow within the Fruitland Formation ceased.

The conceptual model developed from 100 data points of poorly understood geochemical data cannot be supported when 100 data points do not match the work of others who have analyzed multiple lines of physical evidence of fluid flow and workers who have used hundreds of thousands of data points in the analysis. Furthermore, the He-4 ages dates from Zhou et al. (2002 and 2003) show groundwater ages that are orders of magnitude lower than the I-129 age dates. BLM continues to work with multiple lines of physical and chemical data, along with direct observations on the outcrop, to describe the effects of CBM development in the San Juan Basin. Furthermore, several compartmentalization scenarios were tested with the 3M flow model. These scenarios showed conclusively that the pre-development pressure field in the Fruitland Formation cannot be maintained for the millions of years required by the conceptual model put forward by BP.

## 3.5.4 Groundwater — Surface Water Interactions

General flow patterns in the Fruitland Formation are from the recharge areas along the high-elevation ridges of the outcrop to the discharge areas at the river cuts. Figure 3–23 and Figure 3–24 illustrate the general flow paths of groundwater in the Fruitland Formation and Pictured Cliffs Sandstone before CBM development began.

Hydrologic budgets for the Fruitland Formation were developed during the 3M Study. Coals in the Fruitland Formation were estimated to transport approximately 280 acre-feet/year from recharge areas to discharge areas. This estimate applies to the entire San Juan Basin. In the Project Area; approximately 200 acre-feet/year are accounted for by recharge and river discharge. The remaining

80 acre-feet/year flows into the deep basin and discharges at the Rio Puerco and San Juan River in New Mexico.

More detailed modeling, supported by the Ground Water Protection Research Foundation (2001), demonstrated that CBM development will ultimately intercept the groundwater that discharges to the Animas, Pine, Florida, and Piedra Rivers, all located in the Project Area.

Current effects of CBM development show that 65 acre-feet/year are being intercepted and are no longer discharging to the area rivers. Effects of additional infill wells were found to be minimal, with an additional depletion of 5 acre-feet/year at the Florida River. Depletions in surface water flow at the Animas, Pine, and Piedra Rivers were not sensitive to well spacing of 320 acres or 160 acres.

Maximum depletions will be approximately 200 acre-feet/year from all four rivers. This volume of depletion is predicted to occur between 2025 and 2075 and to continue for several centuries or until the Fruitland aquifer is recharged. After the aquifer is recharged, the surface water and groundwater interactions will return to the pre-CBM development conditions.

### 3.5.5 Groundwater Use

Groundwater resources in the Fruitland Formation and Pictured Cliffs Sandstone are exploited at the outcrop, or near the rim of the basin where burial depths are less than 500 feet. In two cases, deeper wells tap into the Pictured Cliffs Formation (Wildarado Ranch and Artesian Valley). These wells are deeper than 1,000 feet. The Wildarado Ranch well was originally drilled as a gas exploratory well and was eventually converted to a water well and conveyed to the landowners for their use.

Twenty shallow domestic wells draw groundwater from the Fruitland Formation or Pictured Cliffs Sandstone near the outcrop areas. These water wells are less than 300 feet deep, and many draw water from coal bed aquifers, which are higher in permeability and provide better yield when compared with the saturated mudstones and sandstones. One shallow groundwater well is an artesian well (Sec 19, T34N, R6W). The well is located immediately south of the outcrop of the Fruitland Formation ridge, in a small pasture underlain by weathered Kirtland Shale. This well is used for stock water, and overflow from the stock tank is used to irrigate a small portion of a nearby pasture. Other shallow wells on the outcrop appear to be situated in the immediate recharge areas; therefore, these wells are not artesian.

### 3.5.6 Public Scoping Issues

*Issue 1: The effects of additional CBM development on groundwater resources.*

The following are specific facets of this issue:

- *Potential for CBM dewatering to deplete groundwater in shallow aquifers.*

- *Altering the basin hydrology by injection of produced water into deeper formations.*
- *Will increased dewatering in the Fruitland Formation adversely affect water wells by lowering the water table?*
- *Will dewatering the Fruitland Formation lead to mixing of groundwater?*
- *Will injection in deeper formations lead to mixing of groundwater?*
- *Will mixing of groundwater adversely affect groundwater supplies by increasing the total dissolved solids or other dissolved constituents?*
- *Will water rights be affected by alteration of the basin hydrology?*
- *Will CBM dewatering and injection affect surface water where there is groundwater and surface water interaction?*

## 3.5.7 Current Conditions — Groundwater Effects from Existing CBM Development

CBM development effects on groundwater resources can be divided into effects on shallow groundwater that is exploitable for water supplies (domestic or livestock), direct effects of withdrawals on the Fruitland Formation and Pictured Cliffs Formation, and direct effects of injection of produced water into deeper aquifers such as the Dakota Sandstone and the Entrada Formation.

### 3.5.7.1 Effects on Shallow Groundwater

Currently, 20 domestic water supply wells use the Fruitland Formation or the Pictured Cliffs Sandstone as the source of water. CBM development has directly affected one domestic well, located in the Texas Creek drainage, by lowering the water table to the point the well required replacement with a deeper well. The original water well drilled at Texas Creek was installed to a depth of 90 feet. Water levels were normally at about 20 to 30 feet, with a sustained yield of 20 gpm. No problems with water quantity were encountered for the 10 years that preceded the start of CBM development. Within 6 years, the water levels had diminished to 65 feet below ground surface, with no changes in water demand. Yield had dropped to less than 1 gpm. The deeper replacement well was 190 feet deep and continues to provide sufficient water quantities to the owners. Water level measurements collected from this well indicate seasonal fluctuations, but no long-term decline has been observed. Direct effects at other domestic wells have not been documented or reported.

Some landowners have complained that CBM development has affected the water supply during hydrofracturing or cavitation. It is likely that the local vibrations induced by these activities may loosen or suspend some of the fine-grained materials around the shallow domestic wellbores, causing discoloration of the water from these wells. These conditions are temporary, and landowners report that the discoloration clears up several days after the work at the CBM well is completed. Another factor that may contribute to discoloration of the groundwater produced from shallow wells is the poor condition of many shallow domestic wells. Often, landowners are not aware of maintenance that is required on domestic wells, such as periodic well development and disinfection. When well maintenance is neglected, even slight vibrations may agitate fine-grained material into suspension, causing discoloration of the water for several days.

### 3.5.7.2 Direct Effects of Groundwater Withdrawals from CBM Wells

Approximately 25,000 barrels of water per day are produced from the existing CBM wellfield in the Project Area. This water is almost exclusively produced from the coal beds, with minor amounts produced from the Pictured Cliffs Sandstone, such as at the Dulin D-1 well.

The water budget for a typical CBM well completed in the Fruitland Formation shows that 990,000 barrels of water are contained in the coal beds within a 160-acre spacing unit. This water is the volume found in the cleat porosity (primary porosity) of the coal beds. A typical well in the Fruitland Formation has produced approximately 250,000 barrels of water since it began producing. Therefore, only a fraction of the water contained in the Fruitland Formation coal beds has been produced by the typical well completed in the Fruitland Formation to date. Furthermore, no significant volume of water has been leaked into the coal beds from overlying strata, nor have the CBM wells in the Fruitland Formation produced significant quantities of water from the Pictured Cliffs Sandstone on a regional scale. Locally, several wells appear to be pumping water from the Pictured Cliffs Sandstone.

As discussed above, the Kirtland Shale effectively seals off the shallow aquifers from the Fruitland Formation, thereby isolating the hydraulic effects of CBM development from the shallow aquifers.

### 3.5.7.3 Direct Effects of Produced Water Injection into Deeper Aquifers

Approximately 12,000 barrels per day of produced water are injected into the Dakota Sandstone and 13,000 barrels per day are injected into the Entrada Formation.

As pressure builds up in the Dakota and Entrada Formations from injection of produced water, the pressure in these formations will gradually increase within a specified radius from the injection well. Increases in pressure at any point within these formations are a function of the injection well's operating pressure, which depends on the injection rate and the thickness and permeability of the formation. EPA and Colorado regulations require all injection wells be operated so that the injection pressures do not induce fracturing in the formation, thereby confining the injected water in the target zone.

Current effects involve the gradual increases in formation pressures. Previously, one effect on groundwater resources was the observed increase in flow and temperature at the Hickerson Hot Spring that occurred when injection began at the Simon Land and Cattle injection well operated by BP. Initially, produced water was injected into the Wanakah Formation. When the well was recompleted to inject produced water in a different zone (the Dakota Formation), there was a corresponding decrease in flow rates and temperatures at the Hickerson Hot

Spring. These decreases indicated an interconnection between the injection well and the hot spring.

This correlation between flow rates and temperatures at the hot spring and the operating history of the injection well indicates a regional open fracture system or open fault zone that interconnects the deeper parts of the San Juan Basin and the outcrop areas of the lower Cretaceous strata. This case is isolated, however. Still, other instances may come to light after new injection wells are installed and begin operating.

Mixing between produced water and the native formation waters will not affect exploitable or useable groundwater resources in the San Juan Basin because no groundwater supply wells tap into the formations where water is disposed.

## 3.5.8 Affected Resources and Environmental Consequences — Groundwater

CBM development in the San Juan Basin affects useable groundwater resources along the outcrop of the Fruitland Formation. Other groundwater resources are affected by the withdrawal of water from Fruitland coal beds and the injection of this water into deeper formations.

Increased development will increase the total volume of water extracted from the coal beds and injected into the deeper formations.

Increased CBM development will also increase drawdown of shallow groundwater resources along the outcrop of the Fruitland Formation, possibly to the point where the domestic wells are no longer viable. As many as 20 well owners may be affected by lower water tables in the outcrop area.

The two deeper wells known to draw water from the Pictured Cliffs Sandstone are not likely to be affected to any significant degree by increased CBM development activity. Rather, lowering the water levels in these wells will continue as a result of the existing level of CBM development.

Impacts discussed for each alternative below are restricted to the outcrops of the Fruitland Formation and Pictured Cliffs Sandstone. Impacts to groundwater resources within the interior of the basin are considered highly unlikely to occur. Shallow aquifers in the San Juan Basin are hydraulically isolated from the Fruitland Formation and will not be depleted by CBM development.

### 3.5.8.1 Alternative 1 —Proposed Action

#### *3.5.8.1.1 Potential for CBM Dewatering to Deplete Groundwater in Shallow Aquifers*

As noted above, the Fruitland Formation is a confined hydrostratigraphic unit throughout most of the Project Area. Dewatering the coal beds will not affect the shallow aquifers that supply nearly all the domestic wells, municipal wells, and livestock wells in the Project Area.

Increased development of CBM will continue to draw down the water levels in wells located along the outcrops of the Fruitland Formation and Pictured Cliffs Sandstone. It will also continue to lower water levels in the two wells known to draw water from the Pictured Cliffs within the interior of the basin.

#### 3.5.8.1.2 Altering the Basin Hydrology by Injection of Produced Water into Deeper Formations

Although the deep hydrology of the basin will be affected by injection of produced water, these effects are not expected to manifest themselves in shallow aquifers or useable groundwater supplies. In other words, the injected produced water will increase pressure in the deep formations and alter the chemistry of groundwater in the deep formations. However, these effects will not be evident so long as injection wells are constructed and operated according to current regulations and best engineering practices.

#### 3.5.8.1.3 Mixing of Groundwater through Dewatering and Injection

Mixing will occur through injection of produced water into deeper formations.

Mixing groundwater between aquifers will not occur from dewatering the Fruitland Formation.

The proposed action will increase the amount of groundwater mixing in deeper formations by increasing the overall volume of injected water and the number of disposal wells that inject produced water.

#### 3.5.8.1.4 Domestic Water Wells

##### Domestic Wells on Outcrop

As noted above, 20 private wells are located on the outcrops of the Fruitland Formation and Pictured Cliffs Sandstone. Any number of these private well owners could be affected by ongoing CBM production. Alternative 1 will not accelerate these potential effects, however.

##### Deeper Water Wells

The two deeper water wells in the Pictured Cliffs Sandstone (Wildarado Ranch and Artesian Valley) have been affected by current CBM development. Alternative 1 may accelerate the drawdowns observed in these two wells by accelerating pressure depletions in the Fruitland Formation and the Pictured Cliffs Sandstone. The overall effect on these two private wells would be to limit the useable quantities of water available to the well owners.

#### 3.5.8.1.5 Groundwater

Groundwater resources will be affected at the outcrop areas of the Fruitland Formation and the Pictured Cliffs Sandstone under Alternative 1. Effects in the western Project Area are not expected to increase under Alternative 1. Effects in the eastern Project Area will include drawdown of the water table along the outcrop, with possible effects on groundwater seeps and springs. Groundwater discharging to the Piedra River from the Fruitland Formation will be intercepted and there

there will be an associated reduction in base flows to the Piedra River. For further discussion, see Section 3.6, Surface Water.

#### 3.5.8.1.6 Surface Water and Water Rights

Impacts to surface water resources and water rights are discussed in Section 3.6, Surface Water.

#### 3.5.8.1.7 Wildlife

Wildlife may be affected by withdrawals of groundwater from the Fruitland Formation only insofar as they relate to the interactions between groundwater and surface water. Springs along the outcrop may dry up, and there will be minor depletions in base flows of surface water in rivers and creeks that are fed by groundwater discharge from the Fruitland Formation. These effects are discussed in Section 3.6 on Surface Water.

### 3.5.8.2 Alternative 1A

#### 3.5.8.2.1 Potential for CBM Dewatering to Deplete Ground water in Shallow Aquifers

This alternative would continue to draw down the water levels in domestic wells along the outcrop of the Fruitland Formation and Pictured Cliffs Sandstone. Drawdowns may not be observed in all domestic wells because of their proximity to recharge areas. However, it is expected that some number of the 20 known private domestic wells will be affected by drawdowns associated with CBM development.

#### 3.5.8.2.2 Altering the Basin Hydrology by Injection of Produced Water into Deeper Formations

Impacts would be the same as described for Alternative 1.

#### 3.5.8.2.3 Mixing of Groundwater through Dewatering and Injection

Impacts would be similar to Alternative 1.

#### 3.5.8.2.4 Domestic Water Wells

Impacts would be the same as described for Alternative 1.

#### 3.5.8.2.5 Groundwater

This alternative would affect ground water resources at the Fruitland and Pictured Cliffs outcrop areas. Effects in the western Project Area are not expected to increase under Alternative 1A. However, effects in the eastern Project Area would include drawdown of the water table along the outcrop, with possible effects on groundwater seeps and springs. Groundwater that discharges from the Fruitland Formation to the Piedra River would be intercepted and there would be an associated reduction in base flows to the Piedra River.

#### 3.5.8.2.6 Surface Water

Impacts to surface water resources are discussed in Section 3.6, Surface Water.

#### *3.5.8.2.7 Wildlife*

As described under Alternative 1, wildlife may be affected by withdrawals of groundwater from the Fruitland Formation only insofar as they relate to groundwater and surface water interactions. Springs along the outcrop may dry up and there would be minor depletions in surface water base flows in rivers and creeks fed by the discharge of groundwater from the Fruitland Formation.

### 3.5.8.3 Alternative 1B

#### *3.5.8.3.1 Potential for CBM Dewatering to Deplete Ground water in Shallow Aquifers*

As with Alternatives 1 and 1A, this alternative would continue to draw down the water levels in domestic wells along the outcrop of the Fruitland Formation and Pictured Cliffs Sandstone. Drawdowns may not be observed in all domestic wells because of their proximity to recharge areas. However, it is expected that some number of the 20 known private domestic wells will be affected by drawdowns associated with CBM development.

#### *3.5.8.3.2 Altering the Basin Hydrology by Injection of Produced Water into Deeper Formations*

Impacts would be the same as described for Alternatives 1 and 1A.

#### *3.5.8.3.3 Mixing of Groundwater through Dewatering and Injection*

Impacts would be similar to Alternatives 1 and 1A.

#### *3.5.8.3.4 Domestic Water Wells*

Impacts would be the same as described for Alternatives 1 and 1A.

#### *3.5.8.3.5 Groundwater*

This alternative would affect ground water resources at the Fruitland and Pictured Cliffs outcrop areas. Effects in the western Project Area are not expected to increase under Alternative 1B. However, effects in the eastern Project Area would include drawdown of the water table along the outcrop, with possible effects on groundwater seeps and springs. Groundwater that discharges from the Fruitland Formation to the Piedra River would be intercepted and there would be an associated reduction in base flows to the Piedra River.

#### *3.5.8.3.6 Surface Water*

Impacts to surface water resources are discussed in Section 3.6, Surface Water.

#### *3.5.8.3.7 Wildlife*

As described under Alternatives 1 and 1A, wildlife may be affected by withdrawals of groundwater from the Fruitland Formation only insofar as they relate to groundwater and surface water interactions. Springs along the outcrop may dry up and there would be minor depletions in surface water base flows in rivers and creeks fed by the discharge of groundwater from the Fruitland Formation.

### 3.5.8.4 Alternative 2

#### 3.5.8.4.1 Potential for CBM Dewatering to Deplete Groundwater in Shallow Aquifers

This alternative would accelerate the drawdowns in domestic wells along the outcrop belt of the Fruitland Formation and Pictured Cliffs Sandstone. Drawdowns may not be observed in all domestic wells because of their proximity to recharge areas. However, it is expected that some number of the 20 known private domestic wells will be affected by drawdowns associated with CBM development.

#### 3.5.8.4.2 Altering the Basin Hydrology by Injection of Produced Water into Deeper Formations

Impacts will be similar to Alternative 1. The primary difference is that increases in pressure in deeper formations will extend over a broader area because of the increased number of injection wells.

#### 3.5.8.4.3 Mixing of Groundwater through Dewatering and Injection

Impacts will be similar to Alternative 1. This alternative will increase the amount of groundwater mixing in deeper formations by augmenting the overall volume of injected water and the number of disposal wells injecting produced water.

#### 3.5.8.4.4 Domestic Water Wells

See the discussion for Alternative 1.

#### 3.5.8.4.5 Groundwater

Groundwater resources will be affected at the outcrops to the Fruitland Formation and Pictured Cliffs Sandstone under Alternative 2. Effects in the western Project Area are would increase under Alternative 2 because of the increased density of CBM wells near the recharge areas.

Effects in the eastern Project Area would include a more rapid drawdown of the water table along the outcrop compared with Alternative 1. Effects on groundwater seeps and springs would also be more rapid. The acceleration of impacts along the outcrop areas is caused by the increased density of CBM wells near the recharge areas at the outcrop and the more pronounced effects of the operation of these wells on the hydrogeologic conditions at the outcrop.

Groundwater that discharges to the Piedra River from the Fruitland Formation will be intercepted, and there will be an associated reduction in base flows to the Piedra River. With Alternative 2, this depletion in surface flows would be accelerated. For further discussion, see Section 3.6, Surface Water.

#### 3.5.8.4.6 Surface Water

Impacts to surface water resources will be discussed in Section 3.6, Surface Water.

#### *3.5.8.4.7 Wildlife*

Overall, impacts to wildlife are likely to be greater when compared with Alternative 1. They will be greater because operation of a dense network of CBM wells in close proximity to the recharge areas along the outcrop is likely to have a more direct effect on groundwater seeps and springs. Alternative 2 is likely to dry up more sources of water more rapidly than will Alternative 1.

### 3.5.8.5 Alternative 3

Effects on groundwater resources would be similar under Alternative 3 and Alternative 1. The only difference would be that Alternative 3 would result in a slightly lower rate of produced water injected into deeper formations.

The impact would be similar because development along the outcrop areas would not be curtailed under Alternative 3; therefore, all impacts to groundwater under Alternative 1 would also be likely to occur under Alternative 3.

### 3.5.8.6 Alternative 4

Effects on groundwater resources would be similar under Alternative 4 and Alternative 1. The differences between the alternatives are:

- Alternative 4 would result in a slightly lower rate of produced water injected into deeper formations.
- Alternative 4 would result in less groundwater intercepted before discharge at the Piedra River, and,
- Alternative 4 may result in slower, or reduced, declines in the water table in the outcrop in the eastern portion of the Project Area.

### 3.5.8.7 Alternative 5 — No Action

Alternative 5 would result in much lower impacts to the water table in the outcrop of the Fruitland Formation in the eastern portion of the Project Area. However, it would only incrementally decrease the number of private domestic wells that would be affected by CBM development because most of the known private domestic wells located on the outcrop of the Fruitland Formation are in La Plata County in an area already subject to possible groundwater depletions.

Impacts to wildlife would be reduced under Alternative 5 when compared with other alternatives because there is a much lower likelihood that sources of water fed by the Fruitland Formation along the outcrop belt would dry up.

Alternative 5 would also inject lower amounts of produced water into deeper formations, reducing the amount of mixing and the degree of pressure buildup in these deeper formations.

## 3.5.9 Cumulative Effects

Groundwater extraction will ultimately have effects on wildlife and possibly riparian areas through the drying of seeps and springs. It will deplete surface water volumes in the rivers to varying degrees, which in turn will affect some water rights (see Surface Water Section).

Deep injection effects, such as mixing different water types or pressuring the receiving formation, will not be observed in the human environment, and will have no effects on other resources.

Groundwater drawdown at the outcrop will also affect some of the domestic wells that tap the Fruitland Formation for their supply.

Alternatives 1 through 4 will all have similar levels of cumulative effects on the groundwater resources. Only Alternative 5 would see a measurable reduction in the overall effects.

## 3.5.10 Mitigation and Monitoring

Unless otherwise stated, the following measures will be funded by the Companies. Mitigation measures for groundwater effects include:

1. Requiring operators to replace affected domestic wells on the Fruitland outcrop with an alternative permanent water source (i.e., new well or a cistern with water delivery service provided by the operator indefinitely)

2. Treating and discharging CBM produced water into area streams to replace the volumes depleted through CBM production. This would require further analysis and permitting before implementation.

The following monitoring program can be implemented to address groundwater effects for any of the alternatives. The scale of the monitoring program can be tailored to the selected alternative.

1. Install 12 to 20 shallow groundwater-monitoring wells along the outcrop of the Fruitland Formation, to evaluate whether the effects of CBM dewatering extend to the outcrop in all areas, or whether portions of the outcrop may be hydraulically isolated from the downdip producing areas.

2. Inventory springs, wells, and groundwater seeps (wetlands) along the outcrop of the Pictured Cliffs and Fruitland and Kirtland Formations.

3. Continue monitoring water levels at the Walker well (Texas Creek), the Meloche well (Pine River area – Kirtland Formation), and the Bureau of Reclamation piezometers in the Ridges Basin area.

4. Monitor water levels at springs and wells, measure flows at springs (download dataloggers, maintain database).

5. Collect time-series water chemistry and temperature data from producing CBM wells.

6. Install and maintain a weather-monitoring station to measure precipitation, temperature, barometric pressure, and wind speed and direction.

## 3.5.11 Conformance to Existing Plans and Policies

For all alternatives, groundwater depletions are predicted to impact surface waters and surface water rights. This is a result of CBM wells intercepting and producing groundwater that otherwise would have contributed to the recharge of surface waters in the Project Area.

Surface water rights are administered by the State Engineer's Office in Colorado. To comply with the regulations and policies of the State Engineer's Office, the Companies may be required to obtain surface water rights or enter into water augmentation plans to compensate for ground water depletions and subsequent surface water impacts. See Surface Water and Wildlife Sections also.

## 3.5.12 Unavoidable Adverse Effects

The effects discussed in previous sections are considered unavoidable adverse effects. These include:

1. Drying of water seeps and springs
2. Associated effects on wildlife and vegetation types
3. Dewatering domestic wells along the outcrop
4. Depletion of surface water flows in area rivers

Technically and economically feasible mitigation measures have not been identified for these effects.

## 3.5.13 Irreversible and Irretrievable Effects

Irretrievable effects on groundwater resources include localized depletions of groundwater in the Fruitland aquifer near the outcrop and depletions of surface water flows in the Animas, Florida, Pine, and Piedra Rivers.

The volume of lost resource will be approximately 100 to 160 acre-ft/yr of surface water flows in these rivers. Long term (50+ years), the cumulative volume of water lost in the surface water system will be between 5,000 and 8,000 acre-ft. Eventually, the Fruitland aquifer system will recharge, and the surface water contributions will be restored.

Groundwater drawdown at the outcrop will affect up to 20 domestic well owners, and these effects are expected to occur beyond the life of the project (30+ years). Eventually (40+ years), the shallow Fruitland aquifer system should be restored to pre-development levels and domestic wells should be able to provide a supply of water to the well owner.

# 3.6 Surface Water Resources

## 3.6.1 Issues

*Issue 2: How does CBM development affect the Project Area's surface water resources?*

Numerous issues relating to impacts on surface water were brought up during the scoping process. These issues are

- *What are the adverse effects of CBM development on surface water quality?*
- *Will access roads and pipelines degrade water quality?*
- *Will irrigation waters be affected by road and drill pad dust?*
- *How will stormwater runoff be controlled?*
- *Does the process of dewatering the Fruitland reduce surface water flows and affect associated riparian areas/?*
- *What is the interaction between the Fruitland Aquifer and surface water systems after gas production ceases?*
- *To what extent does CBM production result in drying of springs and seeps, located along the Fruitland and Pictured Cliffs outcrops?*
- *How much domestic and irrigation water will be consumed by CBM production during the project and how will that affect current users?*
- *Does further CBM production affect existing surface water rights?*
- *Can produced water reasonably be put to beneficial surface uses rather than injected into deep formations?*

These issues fall into the categories of (1) Water Quality Impacts (Chemical Changes and Physical/Sediment Changes), (2) Surface Water Depletions, and (3) Water Use and Water Rights.

This section evaluates impacts to surface water resources within the Project Area. It also interprets the potential impacts that may extend beyond the boundaries of the Project Area for rivers and streams that cross or lie below the Project Area. The criterion used to assess impacts focuses on the potential for changes in water quality or quantity. Measures to mitigate or avoid potential impacts on surface water resources are presented. Direct impacts are defined as effects associated with the activity or disturbance that has an immediate impact on surface water quality or quantity. Examples of direct impacts are sedimentation from erosion during construction of the drill site, pipeline, or road, or contamination that results from spills.

## 3.6.2 Affected Environment

### 3.6.2.1 Regional Characterization of Surface Water Hydrology

The climate in the Project Area is semi-arid, with an average annual precipitation of 25 inches. June is the driest month, averaging less than 1 inch of rainfall. Winter precipitation is mostly in the form of snowfall. Seasonal snowpack in the San Juan Mountains can reach 100 inches or more (Kernodle 1996). Spring runoff from the melting snowpack accounts for most of the streamflows within the Project Area and is heaviest in May, June, and July. Local thunderstorms in the summer may result in considerable amounts of rainfall in a short time that may cause flash flooding.

Average data for annual runoff and peak flow have been compiled from USGS stream gauging stations in the vicinity of the Project Area. This information is presented in Table 3–9. USGS gauging stations are illustrated on Figure 3–25.

The Project Area encompasses portions of seven fifth-level watersheds, identified on Figure 3–26. The characteristics of the watersheds within the Project Area are summarized on Table 3–10.

#### *3.6.2.1.1 Middle Animas Valley*

The Animas River within the project area is generally in good condition. The river has been classified as a "Gold Medal Water" through much of the project area and supports healthy trout populations (Japhat 2003). Roads, residences, and commercial development occur all along the river corridor, but primarily on terraces above the river. Riparian vegetation exists mainly in the form of willow/box elder/cottonwood stands. The river is stable and water quality is fair to good. Several watersheds of the Animas River were burned during the Missionary Ridge Fire of 2002. Subsequent floods recently introduced large loads of sediment to the river. Future impacts of concern include changes in natural flow regimes from upstream water development changes in water quality due to stormwater runoff in developed areas, sedimentation from the Missionary Ridge burned area (Burned Area Emergency Response Team [BAER] 2002) and future construction and floodplain development, and exotic riparian plant establishment.

#### *3.6.2.1.2 Lower Florida River*

The existing condition of the Florida River through the project area is poor. Natural flow regimes have been disrupted by reservoir-regulated flows. The Missionary Ridge Fire of 2002 burned several Florida River watersheds (BAER 2002). Flooding after the fire introduced tremendous quantities of sediment into the Florida River. The Florida River is heavily utilized for irrigation and other consumptive uses. Drought, low reservoir levels, and other water diversions have periodically left very little water in-channel. A once-thriving fish population has recently been eliminated in many places due to low instream flows, flooding, and sedimentation. Future impacts of concern to the Florida watershed include activities that would add to water shortages or add to the existing sediment load in the river and its tributaries.

**Table 3–9 Historical Streamflow at Selected USGS Gauging Stations**

| | Animas River at Durango, Colorado USGS Station #09361500 | Animas River near Cedar Hill, NM USGS Station #09363500 | Wilson Gulch near Durango, Colorado USGS Station #09362550 | Florida River below Florida Farmer's Ditch USGS Station #09363050 | Pine River at Ignacio, Colorado USGS Station #09353800 | Piedra River near Arboles, Colorado USGS Station #09349800 |
|---|---|---|---|---|---|---|
| Drainage Area ($mi^2$) | 692 | 1,090 | 6.5 | 107.0 | 340 | 629 |
| Highest Annual Mean (cfs)[1] | 1,489 1941) | 1,952 (1941) | 1.75 (1997) | 118 (1973) | 125 (2001) | 820 (1979) |
| Lowest Annual Mean (cfs)[1] | 293 (1977) | 324 (1977) | 0.78 (2000) | 4.2 (1977) | 30.7 (2000) | 92.1 (1977) |
| Maximum Peak Flow (cfs)[2] | 25,000 (10/5/11) | 13,100 (6/19/49) | 34 (8/6/99) | 1,100 (5/19/73) | 1,100 (6/12/01) | 8,370 (9/6/70) |
| Minimum Daily Discharge (cfs)[3] | 94 (3/2/13) | 89 (8/27/02) | 0.06 (10/15/00) | 0.7 (10/14/68, 10/17/73) | 0.33 (8/16/02) | 3.9 (8/02) |
| 1 Period of Record | 1920–2001 | 1934–2001 | 1996–2001 | 1968–1981 | 2000–2001 | 1963–2001 |
| 2 Period of Record | 1909–2001 | 1935–1999 | 1996–2001 | 1968–1982 | 1999–2001 | 1963–2001 |
| 3 Period of Record | 1897–2002 | 1933–2002 | 1995–2002 | 1967–1982 | 1999-2002 | 1962–2002 |
| Source: USGS 2003 | | | | | | |
| Annual Runoff (acre-feet)[1] | 598,400 | NA | 1.9 | NA | 58,280 | 297,600 |
| Source: Crowfoot et al. 2002 | | | | | | |

### 3.6.2.1.3 Lower Los Pinos River Watershed

Smaller sub-watersheds in the Lower Los Pinos River watershed include several intermittent/ephemeral drainages: Ute Creek, Reservoir Canyon, Green Canyon, and Spring Creek in the east. Dry Creek and Homer Canyon are located in the west part of the watershed.

Existing disturbance in the Spring Creek sub-watershed is low to moderate. This is a stream system prone to flash flooding during intense thunderstorms. FSR 537 and several CBM well access roads are located alongside the drainage and its tributaries. The drainages for Green Canyon, Reservoir Canyon, Ute Creek and its tributary, Ritter Canyon, have low levels of existing disturbance on federal lands. Green Canyon, Ute Creek, and Reservoir Canyon are highly modified by agriculture on private lands. The level of existing disturbance in the lower and upper reaches of Dry Creek is moderate, with several stream crossings and road segments located within the WIZ.

### 3.6.2.1.4 Middle Los Pinos Watershed

The watershed includes the main stem Los Pinos River, a small portion of Bear Creek, and Wallace Gulch, an intermittent tributary. The Pine River within the project area is in good to fair condition. The natural flow regime has been disrupted by reservoir-regulated flows. Because water is transferred from Vallecito Reservoir to lands within and south of the project area, instream flows tend to be present through this reach. Streamflow is most limiting November through January.

## Table 3–10 Characteristics of Watersheds within the Project Area

| Watershed | HUC[1] 5 | Drainage Area within Project Boundary ($mi^2$) | Total Drainage Area ($mi^2$) | Mean Base Elevation within Project Boundary (ft) | Major Rivers | Perennial Tributaries | Intermittent and Ephemeral Tributaries |
|---|---|---|---|---|---|---|---|
| Lower Florida River | 1408010409 | 34.0 | 118.8 | 7,159 | Florida | | Long Hollow<br>Salt Creek |
| Middle Animas Valley | 1408010407 | 9.9 | 109.5 | 6,906 | Animas | | |
| Middle Los Pinos River | 1408010115 | 23.9 | 86.7 | 7,352 | Pine (Los Pinos River) | Bear Creek | South Fork Texas Creek<br>Wallace Gulch |
| Beaver Creek | 1408010116 | 43.8 | 66.1 | 7,428 | | Beaver Creek<br>Sauls Creek | Armstrong Canyon<br>Crowbar Creek<br>Hayden Creek<br>Wickensen Gulch |
| Lower Los Pinos River | 1408010117 | 44.6 | 171.3 | 7,428 | | | Dry Creek<br>Homer Canyon<br>Green Canyon<br>Reservoir Canyon<br>Ritter Canyon<br>Salt Canyon<br>Spring Creek<br>Ute Creek<br>Zabel Canyon |
| Lower Piedra River | 1408010205 | 36.4 | 104.6 | 7,477 | Piedra River | | Blind Gulch<br>Bull Creek<br>Fosset Gulch<br>Goose Creek<br>Ignacio Creek<br>Little Bull Creek<br>Little Squaw Creek<br>Pole Gulch<br>Squaw Creek<br>Sheep Canyon<br>Skull Canyon<br>Turkey Creek<br>Wagon Gulch |
| Stollsteimer Creek | 1408010204 | 3.2 | 128.5 | 6,798 | | Stollsteimer Creek | Deep Canyon |

Notes:
1. HUC = Hydrologic Unit Code
Source: Shafer 2003

The Pine River floodplain through the project area has been heavily developed by irrigated agriculture, with scattered gravel pits, roads, CBM wells, and residences present. Commercial and residential development in the floodplain is most dense around the town of Bayfield. Future floodplain development, gravel mining, and increased water diversions are concerns for the health of this stream.

#### 3.6.2.1.5 Beaver Creek

Much of Beaver Creek and its floodplain have been affected by grazing, agriculture, and Highway 160. The stream is in fair to poor condition and instream flows are very low to non-existent at times due to water diversions. The stream has cut down deeply into its floodplain and is a gully for much of its length. Spills from highway accidents, increased water diversions, increased sedimentation, and floodplain development are concerns to the health of this stream.

#### 3.6.2.1.6 Lower Piedra River

The main stem Piedra River within the project area is generally in excellent to good condition. Flows on the Piedra River are largely unregulated, and maintain a fairly natural flow regime. With the exception of road construction and scattered agriculture, the river and its floodplain have had limited development. Existing disturbance is also low on Bull Creek, Middle Turkey Creek, Lower Goose Creek, Lower Fosset Gulch, Pole Creek, and Little Squaw Creek, the middle and upper reaches of Ignacio Creek, Sheep Canyon, and Blind Gulch.

Moderate to high levels of existing disturbance are observed in the northern and middle part of the watershed on Squaw Creek and lower Wagon Gulch, Little Bull Creek, Upper Goose Creek, Upper Fosset Gulch, and portions of Turkey Creek.

Many watersheds in the HD Mountains are sensitive to erosive due to local geology, sensitive soils, steep slopes, and arid conditions. Destabilization of steep slopes, sedimentation, and floodplain disturbance would be concerns for future development in these watersheds.

#### 3.6.2.1.7 Stollsteimer Creek

Only a small portion of the Stollsteimer Creek watershed is located in the project area. The lower section of Stollsteimer to its Piedra River confluence is in fair condition. Agriculture is the main land-use along the creek. Highway 151 is constructed along its length and has modified the floodplain in places. Instream flows are very low at times as a result of water diversions. Riparian/floodplain impacts and increased instream water depletions are concerns for the future health of this stream.

### 3.6.2.2 Surface Water Quality — Chemical Contamination as a Result of Spills

#### 3.6.2.2.1 Background

The chemical composition of surface water changes continuously. Most changes are related to the amount and the source of water flowing in a stream at any time. The quality of surface water is directly influenced by geology, climate, and anthropogenic influences in a watershed. Examples of anthropogenic influences could include mining, road construction, stream diversions, agriculture, and other land uses.

One general indicator of water quality is salinity. Salinity refers to the amount of total dissolved solids (TDS) in a water sample and is generally expressed as milligrams per liter (mg/L) of TDS. Electrical conductance (EC) can also be used as a measure of salinity and is considerably easier to measure and monitor. EC values for streams in the vicinity of the Project Area are summarized on Table 3–11 USGS water monitoring stations are plotted on Figure 3–25 to show spatial variability.

**Table 3–11 Water Quality Data from Selected USGS Gauging Stations**

| Station | Period of Record | Specific Conductance (EC) µmhos/cm | |
|---|---|---|---|
| Animas River at Durango, Colorado<br>USGS Station #09361500 | 1958, 1971-2001 | Mean | 434 |
| | | Minimum | 100 |
| | | Maximum | 1,010 |
| | | # Samples | 249 |
| Animas River near Cedar Hill, New Mexico<br>USGS Station #09363500 | 1933-1999 | Mean | 467 |
| | | Minimum | 165 |
| | | Maximum | 829 |
| | | # Samples | 105 |
| Wilson Gulch near Durango, Colorado<br>USGS Station #09362550 | 1995-2001 | Mean | 613 |
| | | Minimum | 310 |
| | | Maximum | 780 |
| | | # Samples | 38 |
| Florida River below Florida Farmer's Ditch<br>USGS Station #09363050 | 1976-1982 | Mean | 253 |
| | | Minimum | 60 |
| | | Maximum | 440 |
| | | # Samples | 70 |
| Pine River at Ignacio, Colorado<br>USGS Station #09353800 | 1999-2001 | Mean | 158 |
| | | Minimum | 80 |
| | | Maximum | 263 |
| | | # Samples | 17 |
| Piedra River near Arboles, Colorado<br>USGS Station #09349800 | 1969-2001 | Mean | 281 |
| | | Minimum | 89 |
| | | Maximum | 570 |
| | | # Samples | 230 |

Source: USGS 2003

The surface water in the Project Area is a calcium-bicarbonate type. Baseline water quality is of neutral to slightly alkaline pH (7.0 to 8.0) with moderate concentrations of TDS. Concentrations of TDS typically are lower in the streams at higher elevations and increase significantly downstream in lowland areas. Agricultural runoff, mining, groundwater inflow, and naturally occurring sediments influence concentrations of TDS. Concentrations of dissolved metals in surface waters in the Project Area are typically low or below the detection limit.

Several studies completed near the Project Area indicate that the quality of surface water may have been affected by diversions for irrigation and associated return flows, runoff from erosive soils, naturally occurring minerals, and mining. BOR has identified parameters in the FEIS for the Animas-La Plata Project that can be associated with these activities, such as selenium, salinity, agricultural pesticides, and sediments. These parameters are indicated as the cause for existing degradation of surface waters in the San Juan River basin (BOR 1996). Existing water quality impairments are discussed below.

### 3.6.2.2.2 Impaired Water bodies

The quality of water within the Project Area is protected for designated uses in accordance with State of Colorado water quality standards. These uses are set forth in the Colorado Water Quality Control Commission's Classifications and Numeric Standards for the San Juan River and Dolores River Basins, Regulation No. 34. Beneficial designated uses identified for streams in the Project Area include aquatic life (cold 1), primary contact (recreation 1a), water supply, and agriculture (CDPHE 2002a). An assessment of surface water quality in rivers and streams in these basins that encompass the Project Area shows that 95 percent of stream miles assessed are supporting cold-water aquatic life (CDPHE 2002b).

The State of Colorado 303(d) report for 1998 lists water bodies where water quality is impaired in the Upper San Juan River Basin (CDPHE 2002b). This information is summarized in Table 3–12. Upstream from the Project Area, segments listed with impairments occur on the Animas River and its tributaries. Pollutants of concern include trace metals, specifically aluminum, cadmium, copper, iron, lead, and zinc, and pH, all attributed to historical metal-mining practices in the area as well as to natural mineralization.

**Table 3–12 303(d) Listed Streams that do not meet Water Quality Standards in the Project Area.**

| Water body ID | Water body Description | Portion | Pollutant | Causes |
|---|---|---|---|---|
| COSJAF02 | Animas River and tributaries; Denver Lake to Maggie Gulch | All | Aluminum, Cadmium, Copper, Iron, Lead | Mining |
| COSJAF03B | Animas River; Cement Creek to Mineral Creek | All | Aluminum, Cadmium, Copper, Iron, Lead | Mining |
| COSJAF04A | Animas River; Mineral Creek to Elk Creek | All | pH, Copper, Iron, Zinc | Mining |
| COSJAF04B | Animas River; Elk Creek to Junction Creek | All | Zinc | Mining |
| COSJAF07 | Cement Creek, sources to Animas River | All | Aluminum, Cadmium, Copper, Iron, Lead | Mining |
| COSJAF08 | Mineral Creek, source to South Mineral Creek | All | Aluminum, Cadmium, Copper, Iron, Lead | Mining |
| COSJAF09B | South Fork Mineral Creek, Mineral Creek to Animas River | All | pH, Copper, Iron, Zinc | Mining |

Source: CDPHE 2002b

Downstream of the Project Area, the Little Navajo River, Navajo River, and their tributaries below the San Juan Chama Dam are listed for impairment by sedimentation, although the potential sources are unknown. Navajo Reservoir at the state border is impaired by mercury, potentially from atmospheric deposition. In New Mexico, the San Juan River and two segments of the Animas River are impaired by sedimentation of the stream bottoms. Lake Farmington also is impaired by mercury. Sources of these impairments are attributed to agriculture, resource extraction, and petroleum exploration and production (NMWQCC 2003).

### 3.6.2.2.3 Concerns

Surface water quality in the Project Area could be degraded by accidental spills of produced water or drilling fluids. In the event of an accidental release of drilling fluids caused by failure or an overflow of the pit, drilling fluids could traverse the well pad and migrate toward surface drainages. Furthermore, accidental spills from vehicle refueling operations could affect surface water quality depending on the proximity of water bodies to the refueling locations. In addition, produced water could accidentally spill through a breach in the pipelines. This spill could affect surface water quality near the well sites or along the right-of-way corridors.

There is some concern about water temperatures related to CBM development; however, thermal increases in surface waters caused by CBM development have not occurred in the Project Area and there has been no direct permitted discharge of CBM produced waters to date. Temperatures of thermal springs may increase as a result of CBM development, which could affect the existing temperatures of nearby surface water and potentially alter aquatic habitat. One thermal spring within the Project Area, Hickerson Hot Spring, is discussed along with other effects of CBM development in the following section.

### 3.6.2.2.4 Effects of CBM Development to Date

Currently, limited data have been collected that correlate changes in the quality of surface water to oil and gas production in the Project Area. Impaired water quality downstream of the Project Area has been attributed in part to resource extraction and petroleum exploration and production, according to the State of Colorado 1998 305(b) report, and results primarily from sedimentation. Petroleum hydrocarbons have been identified as a constituent of concern; however, information on water quality is insufficient to establish baseline concentrations of petroleum hydrocarbons in streams in the Project Area. Thus, the existing effects of CBM and conventional oil and gas development cannot be assessed.

Trautner et al. (2001) observed changes in water quality and flow at Hickerson Hot Spring that may have been related to a water disposal well located 9 miles south of the spring. The study found that the water temperature of the spring had increased from 90° F in 1990 to 133° F in 1997. In addition, ionic concentrations in the water were observed to have increased significantly over measurements in 1970 (Trautner et al. 2001). Changes in the characteristics of the spring were thought to be caused by increased aquifer pressure from injection of CBM produced water. Water temperature and flow began to decrease when injection at the distant well ceased in 1998 (Trautner et al. 2001). However, the spring water is more similar chemically to other hot springs in the Animas Valley than to injected wastewater despite the coincidental changes at the spring and well (Trautner et al. 2001). This similarity is to be expected, because it is unlikely that the injected produced water was of sufficient volume to displace the natural waters in the fracture system.

The University of New Mexico (UNM) and the New Mexico Ecological Services Office of the U. S. Fish and Wildlife Service (USFWS) conducted a study of waters downstream of the Project Area (BLM et al. 2000). A review of potential water quality contaminants was part of this study, as were investigations for conservation of the native fish population in the San Juan River. The study concluded that the potential exists for oil and gas development to contaminate surface water and groundwater with polycyclic aromatic hydrocarbons (PAHs), hydrocarbons, and salts.

Based on the information gathered for the UNM report, produced water from CBM wells in New Mexico did not contain appreciable amounts of dissolved hydrocarbons as of 1991 (BLM et al. 2000). However, elevated levels of PAHs have been recorded in fish from the San Juan River Basin, with fossil fuels the most likely source of contamination. The BLM Farmington District conducted a separate study to investigate possible sources of PAHs that could be attributed to the federal oil and gas leasing program in New Mexico. Based on data collected from 1994 through 1996, the oil and gas leasing program was not considered responsible for the contribution of PAHs to habitat for the Colorado pikeminnow and razorback sucker via surface water runoff (BLM et al. 2000). The UNM report also indicated a lack of studies (and therefore site-specific data) on degradation in the quality of surface water caused by oil and gas development in the San Juan River Basin, particularly related to abandoned wells (BLM et al. 2000).

Section 906b(1) of the COGCC Rules and Regulations requires operators to report all spills or releases of exploration and production (E&P) wastes or produced waters that exceed five barrels in volume. As of April 2002, the COGCC database revealed no spills or releases reported from CBM facilities in the Project Area (COGCC 2002a). However, on October 28, 2003, a landowner using a bulldozer hit one of BP America's produced water lines. An estimated 100 barrels of produced water spilled and traveled approximately ⅜ mile down Dry Creek (west of Gem Village and near Highway 160). The water infiltrated the ground. BP is analyzing samples of water; the results are not available to date. Additionally, minor spills or releases of small quantities of drilling fluids, contents of pits, or CBM produced waters were documented, but did not require formal reporting because of the limited volumes.

Operators that store large volumes of oil at CBM facilities are required by Title 40 CFR Part 112 to prepare an SPCC Plan that specifies containment requirements and drainage control measures to prevent any spills from reaching waters of the U.S. No water quality issues from CBM development have been specifically noted in the Project Area, with the exception of accidental discharges of produced water that have apparently resulted in small fish kills in the lower Florida River and its tributary, Salt Creek (Japhat 2002, 2003). These fish kills occurred within the last 10 years; however, no water quality data are available to support these local observations. The fish kills may have been caused by the releases of CBM produced water, or there may have been other causes, such as nutrient loading of the stream from agricultural activity.

## 3.6.2.3 Surface Water Quality — Physical Changes as a Result of Well Pad, Road and Pipeline Construction

### *3.6.2.3.1 Background*

Potential effects to water quality from construction of the well pads, roads, and pipelines include surface erosion and delivery of sediment either directly or indirectly to the stream system.

### *3.6.2.3.2 Concerns*

Stormwater runoff from exposed surfaces can increase streamflow and sediment loads in local drainages. Peak runoff rates can increase as a result of vegetation removal and soil compaction during construction of well pads and access roads. The degree of impact depends on the location of the new facilities and their distance from drainages, rivers and other water bodies. Construction near surface water drainages has the greatest potential to change patterns of streamflow or to alter the channel. Increased runoff and erosion may affect stream channels by increasing bank erosion, channel scour, and sediment loads.

Direct impacts to streams are particularly acute where construction occurs in channels and at sites where roads or pipelines cross perennial streams. The channel has been altered by bridges or culverts in these areas, and sediment is easily transported to streams. The existing road network outside of the watershed influence zone (WIZ) may contribute sediment and chemical contaminants either directly into adjacent streams or indirectly by routing water and sediment through ditches and culverts into streams.

Where CBM roads cross steep, landslide-prone areas, mass failures can result. Mass failures are large sources of sediment that may enter streams directly, especially in steep, dissected terrain.

Surface-disturbing activities, such as construction of the well pad, road, and pipeline reduce vegetative cover in the watershed. This loss of cover increases erosion potential and, consequently, sediment loads in surface streams. Additionally, roads and well pads, and the associated traffic, may also increase fugitive dust loading to irrigation water as it flows through open channels and ditches. Although a minor concern, fugitive dust may affect the quality of irrigation water.

Degradation of surface water quality depends on the size of the disturbed area, the topographic controls, the effectiveness of mitigation, and the proximity of the area to surface drainages.

### *3.6.2.3.3 Effects of CBM Development to Date*

Data are not adequate to conclusively show whether erosion caused by CBM operations has altered water quality in the Project Area. Existing CBM activity has likely had little widespread effects on erosion in the Project Area in light of the small amount of disturbed acreage and use of best management practices (BMPs), which minimize watershed and surface water degradation from well construction and operation. BMPs are listed in Appendix F. CBM development to date has affected approximately 1,496 acres, or 1.2 percent, of the Project Area.

Water influence zones (WIZ) have been delineated to evaluate the proximity of surface drainages and water bodies to CBM surface disturbance. The WIZ is defined as the zone located on either side of a stream that is 100 feet in width, or the height of the tallest tree, whichever is greater. For this analysis, intermittent and ephemeral streams (2nd order and higher), were assigned a WIZ of 100 feet each side of the stream. Perennial streams (such as Beaver Creek, Sauls Creek, and Stollsteimer Creek), and main stems, such as the Animas, Pine, Florida, and Piedra Rivers, were assigned a WIZ of 300 feet on each side of the stream, since these rivers are large with wider riparian zones. Impacts to water quality and floodplains would be greater within the WIZ because eroded soil would be expected to reach the drainage and change the quality of the water flowing through the drainage. Construction of roads and well pads within the WIZ often has direct impacts on floodplains and channel function. Table 3–13 summarizes the acres of disturbance from existing CBM development that occurs within the WIZ of the Project Area.

**Table 3–13 Existing Disturbance by Watershed**

| Watershed | Watershed (Acres) | Existing TOTAL Disturbance (Acres) | Existing TOTAL Disturbance in WIZ[1] (Acres) | Existing Disturbance in WIZ as a Percentage of the existing TOTAL disturbance |
|---|---|---|---|---|
| Beaver Creek | 28,063 | 330.3 | 60.7 | 18.4 |
| Lower Florida River | 21,729 | 358.6 | 29.1 | 8.1 |
| Lower Los Pinos River | 28,557 | 296.4 | 26.3 | 8.9 |
| Lower Piedra River | 23,304 | 175.5 | 41.7 | 23.7 |
| Middle Animas Valley | 6,321 | 87.8 | 6.6 | 7.6 |
| Middle Los Pinos River | 15,323 | 233.6 | 25.0 | 10.7 |
| Stollsteimer Creek | 2,045 | 6.6 | 4.0 | 60.5 |
| Out of Area | NA | 7.6 | 0.0 | 0.0 |
| TOTAL | 125,341 | 1,496.3 | 193.3 | 12.9 |

Note:
1. WIZ = Water Influence Zone

Approximately 193 acres, or 12.9 percent of the surface disturbance from existing CBM development in the Project Area, occurs within the WIZ. Most of this disturbance results from construction of roads. Using the Revised Universal Soil Loss Equation (RUSLE), this existing disturbance corresponds to about 1,638 tons of annual soil loss within the WIZ of the Project Area. The methodology for estimating soil loss using RUSLE is described in detail in the Soils section.

The BLM standard for protection of riparian areas applies to federal actions that affect the WIZ identified for this project. The ROD for the amended San Juan

RMP states, "For the protection of perennial water impoundments and streams, and/or riparian/wetland vegetation zones, activities associated with oil and gas exploration and development including roads, transmission lines, storage facilities, are restricted to an area beyond the riparian vegetation zone."

In addition, Forest Service Handbook (FSH 2509.25) 12.1 Standard (3) and Design Criteria 1 specify that actions are allowed in the WIZ only if they "maintain or improve long-term health of the stream and the condition of the riparian ecosystem. Heavy equipment would be kept out of streams, swales, and lakes, except to cross at designated points, to build crossings, or for restoration work. In addition, new concentrated-use sites would be located outside the WIZ if feasible, and should always be located outside riparian areas and wetlands" (FS 2001c). Adherence to the existing BLM and FS policies and guidelines has minimized impacts to water quality from construction that originates on federal jurisdiction.

The potential for changes in channel morphology and stream health caused by existing CBM development was evaluated by examining the density of roads, the slope gradient, and the proximity to stream channels. This approach provides a quantitative indication of the influence of the existing road system on the hydrologic regime of the watershed and a means for comparing alternatives when impacts are discussed. This information is summarized in Table 3–14, and described below for each of the watersheds in the Project Area.

**Table 3–14 Existing Road Density by Watershed**

| Watershed | Existing Road Density1 (mi/mi$^2$) | Existing Roads on Slopes >40 % (mi) | Existing Roads within WIZ (mi) |
|---|---|---|---|
| Beaver Creek | 2.02 | 0.74 | 17.73 |
| Lower Florida River | 2.13 | 0.64 | 8.64 |
| Middle Los Pinos River | 2.49 | 0.74 | 7.01 |
| Lower Los Pinos River | 1.65 | 3.96 | 6.56 |
| Lower Piedra River | 1.54 | 2.52 | 13.42 |
| Stollsteimer Creek | 0.68 | 0.00 | 1.31 |
| Middle Animas Valley | 1.53 | 0.82 | 1.88 |
| Navajo Reservoir Inlet | 7.00 | 0.00 | 0.00 |
| Total Density of Project Area | 1.87 | 9.42 | 56.55 |

### 3.6.2.3.4 Stormwater Discharge Permits

Currently, the State of Colorado requires that oil and gas operators obtain coverage under the general NPDES permit for stormwater discharges during construction. This Construction General Permit requires operators to prepare stormwater management plans. These plans specify BMPs for erosion and sediment control during runoff from disturbed areas to reduce impacts to surface water quality.

The Construction General Permit applies to construction that disturbs more than 1 acre but less than 5 acres. However, as of June 30, 2003, 1- to 5-acre construction sites associated with oil and gas exploration, production, processing and treatment operations or transmission facilities are no longer required to obtain stormwater permits, at least until March 10, 2005. Although 1- to 5-acre oil and gas construction sites are exempt from coverage until March 10, 2005, oil and gas construction sites that disturb 5 or more acres or are part of a larger common plan of development are not exempt and therefore require a permit.

For the oil and gas industry, a "common plan of development" is interpreted to mean "Development of several well pads and/or related infrastructure (i.e., Roads, pipelines, pumping stations, etc) in a contiguous area either during the same time period or under a consistent plan for long-term development..." (CDPHE 2003). Contiguous is currently defined as sites that are up to ¼ mile apart or when the areas between are connected by site disturbance. Therefore, each company involved in oil and gas development within the Project Area is required to obtain a Construction General Permit for the larger common plan of development.

Currently, there are six active stormwater permits for oil and gas facilities in the Project Area (Bagan 2003). All of these facilities are located in La Plata County. Examples of BMPs that operators have incorporated into the stormwater management plans include installation of silt barriers (silt fences and hay bales) and construction of berms, water bars, and culverts to divert water away from the disturbed area.

Pipeline routings and roads that cross stream drainages and waterways are further regulated by U.S. Army Corps of Engineers (USACE) Section 404 permits under the CWA to prevent discharges of sediment to state waters during construction.

## 3.6.2.4 CBM Development on Irrigation Water Quality and Fugitive Dust

### *3.6.2.4.1 Background*

The majority of the surface water resources in the Project Area are used for irrigation. Diversion ditches and distribution canals may be found near proposed well pads and access roads.

### *3.6.2.4.2 Concerns*

Irrigation waters conveyed in open channels adjacent to heavily traveled roads with a native surface may be affected by dust. Any surface-disturbing activity that reduces vegetative cover in the watershed, such as construction of well pads or roads, can increase emissions of fugitive dust. These emissions in turn influence concentrations and loads of sediment to surface waters used for irrigation.

### *3.6.2.4.3 Effects of CBM Development to Date*

Where fugitive dust settles on surface water bodies that are adjacent to heavily traveled roads with a native surface, minor increases in sediment loads to these drainages are likely. State water quality standards for the protection of agricultural use (for example, irrigation) do not include standards for total suspended soils (TSS); however, water bodies designated for additional uses may be affected by increases in TSS. Existing impacts have been reduced by locating well pads and roads away from open channels and irrigation diversions and using dust inhibitors on the surfaces of roads that could cause emissions of fugitive dust.

## 3.6.2.5 Fruitland Dewatering in Relation to Surface Water Flows and Associated Riparian Areas, Wetlands, and Springs and Seeps

### *3.6.2.5.1 Background*

In the Project Area, groundwater discharges to the surface where stream crossings intersect the outcrop of the Fruitland Formation. Groundwater contributions of the Fruitland Formation to flows in the Animas, Pine, and Florida Rivers are minimal (less than 1 percent) when compared with base flows (AHA 2000). Base flows in these streams result primarily from groundwater discharge from other formations.

Total recharge to the Fruitland Formation in the Colorado portion of the San Juan Basin was estimated during the 3M study to be approximately 208 acre-feet/year (AHA 2000, Questa 2000).

The outcrops of the Fruitland Formation and Pictured Cliffs Sandstone typically do not support riparian habitat. However, springs and seeps situated along the outcrop may support wetland or riparian vegetation. Figure 3–27 shows springs and seeps in the vicinity of the Project Area that occur along the outcrop.

Within the Project Area, riparian vegetation is generally limited to the immediate vicinity of the larger rivers, such as the Animas, Florida, Pine, and Piedra. However, riparian vegetation is along the perennial streams, such as Beaver Creek, Sauls Creek, and Stollsteimer Creek, and intermittent channels, such as Dry Creek and Lange Canyon. Wetlands within the Project Area are generally concentrated near the larger rivers and some perennial streams. Some wetlands occur along the outcrop in association with seeps and springs; others are found scattered throughout the Project Area.

### *3.6.2.5.2 Concerns*

The Fruitland Formation and Pictured Cliffs Sandstone are in direct hydraulic communication with the river and alluvial fill aquifer system (Cox et al. 2001). Groundwater flows from the recharge areas along the high-elevation ridges of the outcrop, to discharge areas at the river cuts. Before CBM development in the northern San Juan Basin, discharge from the Fruitland aquifer to the Animas, Florida, Pine, and Piedra Rivers totaled approximately 194 acre-feet per year (acre-feet/year). Modeling by Cox et al. (2001) has demonstrated that CBM development has and will continue to intercept groundwater that would normally discharge to these rivers, all located in the Project Area.

Riparian and wetland areas associated with these streams could be affected by depletions in surface flows and groundwater discharge. Additionally, springs and seeps along the outcrop could be affected by CBM development as a result of the interception of groundwater that would typically discharge at these springs and seeps. CBM development would increase the drawdown of shallow groundwater resources along the outcrop of the Fruitland Formation, potentially drying up springs and seeps by lowering the water table.

### *3.6.2.5.3 Effects of CBM Development to Date*

The nearest existing CBM well is located more than ¼ mile away from seeps and springs identified along the outcrop. The precise impact of the proximity of a well to seeps and springs is not known; however, site-specific monitoring of seeps and springs along the outcrop is proposed to continuously evaluate impacts from CBM development. Furthermore, relocation or realignment during siting of existing facilities during the APD stage to avoid construction near seeps and springs has helped in reducing potential impacts to date.

Dewatering of the Fruitland Formation as a result of existing CBM Development has not been documented to dry up springs and seeps in the Project Area (Janowiak 2002). However, cases have been documented south of the Project Area where springs have dried up and shallow water wells have been dewatered by CBM development.

To date, 65 acre-feet/year is depleted from surface flows in the Animas, Pine, and Florida Rivers in the northern San Juan River basin (Cox et al. 2001). Figure 3–28 illustrates current depletions (without infill wells) in surface flows in these rivers. To date, CBM development has not affected surface flows in the Piedra River.

Depletions of surface water are expected to peak between 2025 and 2075 and continue beyond the life of the project, likely for several centuries, until the Fruitland aquifer is recharged (Cox et al. 2001). The interaction between surface flows and the Fruitland aquifer would return to pre-CBM development conditions once the aquifer is recharged.

Riparian and wetland areas near the larger rivers have not likely been affected by CBM development. The depletions in surface flows are low when compared with baseflows in these rivers, and no direct impacts have been documented to these areas to date.

## 3.6.2.6 Consumptive Water Uses, Water Rights, and CBM Well Production

### *3.6.2.6.1 Background*

CBM development consumes water through two primary means. First, fresh water is required to drill a well. Second, dewatering the Fruitland Formation to extract CBM gas disrupts the natural recharge of surface water in springs, seeps, and rivers at the Fruitland outcrop. This disruption is an indirect consumption of surface water.

The total surface water withdrawals for the counties that encompass the Project Area equaled 421.7 million gallons per day (MGD) in 1995 (USGS 1995). Table 3–15 summarizes the total water use within La Plata and Archuleta Counties in

1995 (USGS 1995). Irrigation uses the vast majority of surface water consuming about 97 percent of surface water withdrawals (410 MGD) (USGS 1995).

**Table 3–15 Surface Water Use by County, 1995**

| Category | La Plata (MGD)[1] | Archuleta (MGD) | Total (MGD) |
|---|---|---|---|
| Public Supply | 5.49 | 1.77 | 7.26 |
| Commercial | 0.01 | 0.00 | 0.01 |
| Domestic | 0.00 | 0.00 | 0.00 |
| Industrial | 0.05 | 0.00 | 0.05 |
| Mining | 0.02 | 0.00 | 0.02 |
| Livestock | 4.22 | 0.11 | 4.33 |
| Irrigation | 364.75 | 45.30 | 410.05 |
| Total | 374.54 | 47.18 | 421.72 |

Note:
1. MGD = millions of gallons per day

Major communities located in or near the Project Area that use surface water resources as municipal supplies include the towns of Bayfield and Ignacio in Colorado and the Jicarilla Apache Tribe in Dulce, New Mexico. Estimated populations served are 1,800 in Bayfield, 845 in Ignacio, and 1,800 for the Jicarilla. Approximately 6,400 people obtain drinking water from groundwater collectively in the two counties of interest, and 26,730 people draw drinking water from surface water resources (USGS 1995).

The Colorado Department of Water Resources (CDWR) administers water used in the State of Colorado through a system of water rights. A water right (or appropriation) is the right to divert the public waters of the state and put them to beneficial use. The project is located within Colorado Water Division 7.

Surface water rights filed in Division 7 are shown on Figure 3–29. Most of the water rights have multiple beneficial uses. A total of 317.6 cubic feet per second (cfs) and 728.3 acre-feet/year have been adjudicated within the Project Area. The adjudication does not necessarily reflect the amount of water available in any year for the intended uses; instead, it is only a representation of legal claims to the water in a specific stream course.

### 3.6.2.6.2 Concerns

Development of CBM requires fresh water to drill and complete wells. CBM operators would need to purchase water from existing users or apply to the Colorado State Engineer's Office (SEO) for appropriation of water rights. This requirement could affect available water supplies that are used under existing water rights.

There is concern that CBM development may also affect existing water rights by intercepting water that would otherwise be available as instream flow. Many of the streams in the Project Area are over-appropriated during the irrigation season;

any depletion from CBM development during this time will likely affect existing water users.

#### 3.6.2.6.3 Effects of CBM Development to Date

CBM well drilling and completion requires 0.30 acre-feet per well of fresh water. Most of this water is either purchased from a private source (such as landowners with existing surface water rights) or is purchased and trucked in from a local supply. CBM well drilling would shift the amount of consumptive use for irrigation or domestic supply to use for industrial purposes to satisfy this requirement for water. To date, CBM well drilling has generally had minimal effects on consumptive use of surface waters in the Project Area.

Existing CBM development is dewatering the Fruitland Formation, causing a loss of surface water to the major rivers in the analysis area. As of 2001, it has been estimated that 65 acre-feet per year are currently being depleted from the Animas, Florida, and Pine Rivers (Cox et al. 2001). Because many of the streams in the Project Area are over-appropriated during the irrigation season, any loss of water due to CBM development during this time will likely affect existing water users.

##### *Over-Appropriated Streams*

CDWR maintains a list of streams located within Water Divisions of the state that have historically required administration to meet demands by senior water rights, or where water is not adequate during limited periods to meet the needs of the water rights that already have been established. The Project Area is located within Water Division 7, which lists nine districts where streams are over-appropriated. Table 3–16 identifies streams within or adjacent to the Project Area that CDWR considers over-appropriated, that require administration, or that are unable to meet water rights demands.

**Table 3–16 State of Colorado, Water District 7 Over-Appropriated Streams In or Near the Project Area**

| District | Stream | Location | ID | Legal Description | Comment |
|---|---|---|---|---|---|
| 30 | Spring Creek | Above the Macy Ditch | 593 | SE¼, SE¼, Sec. 10, T35N, R9W | Upstream of the Project Area |
| | Florida River | Above Banks-Tyner Ditch | 1,033 | SE¼, NW¼, SE¼ of Sec. 16, T34N, R8W | Within Project Area |
| 31 | Pine River | Above Spring Creek Ditch | 509 | NE¼, NE¼, SE¼ of Sec. 15U, T34N, R7W | Within Project Area |
| | Wallace Gulch | Above the Colorado SW Ditch #2 | 709 | SW¼, NE¼ of Sec. 33, T35N, R7W | Within Project Area |
| | Beaver Creek | Above Citizens Ditch | 569 | NW¼, NE¼ of Sec. 24, T35N, R6W | Within Project Area |
| 78 | Devil Creek | Above the Ford Ditch | NA[1] | SW¼ of Sec. 12, T34N, R4W | Northeast of the Project Area, stream drains to the Piedra River |
| | Stollsteimer Creek | Above Dike Ditch #2 | 539 | NW¼, SE¼ of Sec. 9, T34N, R3W | Stream drains to the Project Area |
| Other | Florida River | NA | NA | NE corner of Sec. 12, T34N, R9W | Within Project Area |

Note:
1. NA = not available
Source: Beegles 1993

Loss of surface water that results from dewatering the Fruitland Formation during CBM development is most problematic in over-appropriated streams. Surface water depletions caused by CBM operations have the highest risk of injuring existing water rights during periods when there is not enough water present. Surface water shortages occur most commonly during the irrigation season.

### 3.6.2.7 Beneficial Use of CBM Produced Waters

#### *3.6.2.7.1 Background*

Water produced from CBM dewatering of the Fruitland Formation (through December 1998) totaled 244 million barrels, or 28,900 acre-feet (Questa 2000). The Fruitland Formation is a regional aquifer with marginal to poor water quality (1,000 to 10,000 mg/L TDS) and low yields (Cox et al 2001). The potential for beneficial use of CBM produced water would depend on the quality of the groundwater extracted from the coals in the Fruitland Formation and the potential use of the water. The suitability of CBM produced water for surface discharge and the limitations on use based on water quality would be established in site-specific discharge permits.

#### *3.6.2.7.2 Concerns*

Some CBM operators are investigating surface discharge of produced water. The quality of the produced water when compared with effluent limitations and water quality standards for the receiving streams would control whether surface discharge would be allowed. Produced water would likely require treatment to meet water quality standards.

#### *3.6.2.7.3 Effects of CBM Development to Date*

CBM produced water has not been discharged to the surface, so there are no environmental effects to date. CBM produced water was used in a limited capacity to support emergency firefighting near the Project Area during summer 2002. At that time, 3,500 barrels of produced water from BP-America's operation was transported to a staging area for use on the Missionary Ridge fire near Durango (Baldwin 2002).

## 3.6.3 Environmental Consequences

CBM impacts to surface waters would occur in, as well as downstream of, the Project Area under all alternatives. Existing and proposed well pads, roads, and pipelines, were evaluated to assess the potential environmental consequences to surface water resources. Short-term impacts would occur during the construction, drilling, and completion phases. Long-term impacts would occur during the production and maintenance, decommissioning, and reclamation phases.

### 3.6.3.1 Surface Water Quality — Chemical Contamination as a Result of Spills

The potential for contaminant spills is directly correlated to the amount of development that takes place in each alternative. The potential for spills to reach water bodies is a function of proximity to streams.

### 3.6.3.1.1 Alternative 1 — Proposed Action

Potential short-term impacts to surface water quality could occur as a result of accidental spills of fuel, lubricants, and fluids during construction of the well pads, associated facilities, roads, and pipelines. Long-term impacts over the life of the project could occur from leaks or breaks in the pipelines that run from the wells to the disposal facilities. During operations, produced water could spill through a breach in the pipelines that convey the water to disposal facilities. Spills could affect surface water quality near injection wells or along the right-of -way corridors.

Short-term increases in salinity would likely occur in adjacent surface waters. Emergency response procedures would be implemented in the event that a pipeline ruptures, and measures would be taken to minimize impacts to water quality from the contents of the pipeline.

Operators use pits to contain drilling fluids during drilling and completion. These pits could fail or overflow, allowing drilling fluids to traverse the well pad and flow into surface drainages. Effects to water quality would depend on the location of the pit in relation to surface drainages, as well as on the amount of fluids released and the adequacy of spill containment and cleanup procedures. Detailed design of well pads, pipelines, and roads as well as spill contingency plans would be completed during the site-specific analysis APD stage of planning.

Vehicle refueling areas could also provide a source of contamination to the quality of surface water. Effects would be minimized by locating refueling stations away from surface drainages and water bodies and storing fuels in bermed areas. Watershed conservation practices require that new sources of chemical pollutants be kept where they would not reach surface waters. The requirement would be met by relocating the well pads outside the WIZ, where possible (FS 2001c). New sources of pollutants would also be isolated from surface waters by installing contour berms and trenches around vehicle refueling areas (FS 2001c).

Construction would require certification under the NPDES general permit, and materials handling and spill prevention procedures would be implemented to contain spills before they could reach surface waters. Companies would also develop site-specific SPCC plans for construction and operation of the facilities to be located on each well pad. These regulatory processes and BMPs would be implemented to minimize impacts to surface water quality from potential spills and leaks. Therefore, the potential for spills and leaks to reach surface water bodies would be long term but minor.

Development under Alternative 1 could result in contaminant spills anywhere throughout the Project Area. Short-term risk would be highest during the construction phase of wells located in the WIZ. If a flood event were to occur while drilling in the floodplain, water may overtop or damage containment berms allowing drilling fluids to enter streams. Drilling outside spring runoff periods or monsoon flood season could decrease the risk of flood damage and spills (see Mitigation section). The Proposed Action involves numerous wells in floodplain areas. The long-term probability of spills is anticipated to be low because of material handling requirements. Long-term impacts would also be low because BMPs and mitigation measures would be implemented (Appendix F). Development would also be subject to federal and state regulations for the protection of water quality standards.

#### 3.6.3.1.2 Alternative 1A

Alternative 1A would present the lower risk for contaminating spills when compared with Alternative 1 because fewer wells, flowlines, and facilities would be constructed. Many wells would be constructed in the WIZ.

#### 3.6.3.1.3 Alternative 1B

Potential effects to surface water quality from spills of petroleum or CBM produced waters would be less under Alternative 1B than is described for Alternative 1 within the National Forest portion of the Project Area because of the fewer well pads and lower activity in the WIZ.

#### 3.6.3.1.4 Alternative 2

Alternative 2 would present the greatest potential for spills based on the amount of development the alternative represents. Effects to surface water quality from spills of petroleum or CBM produced waters would be similar to the effects described for Alternative 1.

#### 3.6.3.1.5 Alternative 3

Alternative 3 presents the same risks as Alternative 1 in the western side of the Project Area. Within the eastern side, there would be no possibility for accidental spills to occur in the HDs Mountain Roadless Area because it would not be developed under this alternative.

#### 3.6.3.1.6 Alternative 4

Alternative 4 presents a lower risk for spills to affect surface water quality than does Alternative 1 because less development would be involved.

#### 3.6.3.1.7 Alternative 5 — No Action

Alternative 5's potential for spills of petroleum or CBM produced waters would be slightly lower than under Alternative 1 in the western side of the Project Area and much lower than Alternative 1 in the eastern side of the Project Area. BLM and FS would not authorize any additional CBM development on federal leases within the Project Area under this alternative. Drilling would, however, continue on private and state leases, where spills of produced water or drilling fluids could affect surface waters in the Project Area.

### 3.6.3.2 Surface Water Quality — Physical Changes as a Result of Well Pad, Road, and Pipeline Construction

Surface erosion and sediment delivery either directly or indirectly to the stream system is a potential consequence of well pads, roads, and pipeline construction. Direct effects would occur if sediment were transported to surface water drainages and water quality impaired. Modification of floodplains due to facility construction in the water influence zone (WIZ) is another direct effect of concern. Indirect effects include alteration of channel morphology as a result of scour, channel instability, and development encroachment on floodplains. Large increases of sediment could force adjustments to the channel as streams reestablish equilibrium between discharge, increased sediment load, and channel morphology. Channel adjustments could result in loss of floodplains, aquatic habitat, and riparian habitat. These potential impacts are analyzed in detail below.

Indicators of direct impacts are presented in Table 3–17 through Table 3–22. These tables summarize the short- and long-term disturbance by watershed resulting from CBM construction and production activities that would occur within the WIZ.

**Table 3–17 Short Term Total Disturbance (Proposed) by Watershed for all Alternatives**

| Watershed | Acres in watershed | Alternative (acres) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Middle Los Pinos River | 15,323 | 65.0 | 65.0 | 65.0 | 122.4 | 65.0 | 65.0 | 61.8 |
| Beaver Creek | 28,063 | 144.0 | 127.2 | 114.3 | 404.1 | 108.7 | 145.1 | 54.0 |
| Lower Florida River | 21,729 | 53.0 | 53.0 | 53.0 | 137.7 | 53.0 | 53.0 | 44.4 |
| Stollsteimer Creek | 2,045 | 53.3 | 41.8 | 8.7 | 61.1 | 53.1 | 0.0 | 0.0 |
| Middle Animas Valley | 6,321 | 13.4 | 13.4 | 13.4 | 71.4 | 13.4 | 10.4 | 13.4 |
| Lower Piedra River | 23,304 | 486.6 | 387.6 | 228.0 | 570.0 | 243.8 | 238.2 | 100.2 |
| Lower Los Pinos River | 28,557 | 200.7 | 180.8 | 151.7 | 379.3 | 159.4 | 200.9 | 87.7 |
| Total for Project Area | 125,342 | 1,016 | 869 | 634 | 1,746 | 696 | 713 | 362 |

Totals for short-term disturbance include acreages of disturbance predicted from windows for yet-undetermined road locations

**Table 3–18 Short-Term Total Disturbance (Proposed) in WIZ**

| Watershed | Acres in watershed | Alternative (acres) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Middle Los Pinos River | 15,323 | 7.8 | 7.8 | 7.8 | 13.1 | 7.8 | 7.8 | 7.8 |
| Beaver Creek | 28,063 | 11.5 | 16.1 | 10.8 | 38.4 | 11.0 | 18.3 | 10.8 |
| Lower Florida River | 21,729 | 5.6 | 5.6 | 5.6 | 13.4 | 5.6 | 5.6 | 2.6 |
| Stollsteimer Creek | 2,045 | 5.5 | 5.0 | 4.9 | 8.1 | 5.6 | 0.0 | 0.0 |
| Middle Animas Valley | 6,321 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lower Piedra River | 23,304 | 55.1 | 48.5 | 22.1 | 57.7 | 31.1 | 44.4 | 23.3 |
| Lower Los Pinos River | 28,557 | 8.7 | 9.0 | 5.6 | 35.5 | 8.7 | 16.6 | 5.2 |
| Total for Project Area | 125,342 | 94 | 92 | 57 | 166 | 70 | 93 | 50 |

Totals for short-term disturbance include acreages of disturbance predicted from windows for yet-undetermined road locations

### Table 3–19 Short-Term Disturbance (Proposed) in WIZ as a Percentage of the Total Short Term Disturbance

| | Acres in | Alternative (percent) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Watershed | watershed | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Middle Los Pinos River | 15,323 | 12.0 | 12.0 | 12.0 | 10.7 | 12.0 | 12.0 | 12.7 |
| Beaver Creek | 28,063 | 8.0 | 12.7 | 9.5 | 9.5 | 10.1 | 12.6 | 20.1 |
| Lower Florida River | 21,729 | 10.6 | 10.6 | 10.6 | 9.8 | 10.6 | 10.6 | 5.9 |
| Stollsteimer Creek | 2,045 | 10.4 | 12.0 | 56.6 | 13.3 | 10.5 | 0.0 | 100.0 |
| Middle Animas Valley | 6,321 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lower Piedra River | 23,304 | 11.3 | 12.5 | 9.7 | 10.1 | 12.8 | 18.7 | 23.2 |
| Lower Los Pinos River | 28,557 | 4.4 | 5.0 | 3.7 | 9.4 | 5.5 | 8.3 | 6.0 |
| Total for Project Area | 125,342 | 9.2 | 10.6 | 9.0 | 9.5 | 10.0 | 13.0 | 13.8 |

Totals for short-term disturbance include acreages of disturbance predicted from windows for yet-undetermined road locations

### Table 3–20 Long-term Total Disturbance (Proposed) by Watershed for all Alternatives

| | Acres in | Alternative (acres) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Watersheds | Watershed | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Beaver Creek | 28,063 | 97.3 | 94.2 | 89.8 | 269.9 | 73.9 | 96.3 | 37.4 |
| Lower Florida River | 21,729 | 35.9 | 35.9 | 35.9 | 93.0 | 35.9 | 35.9 | 29.9 |
| Lower Los Pinos River | 28,557 | 137.1 | 132.7 | 110.1 | 256.0 | 107.6 | 134.3 | 59.3 |
| Lower Piedra River | 23,304 | 312.9 | 270.1 | 176.5 | 368.3 | 159.7 | 154.8 | 64.9 |
| Middle Animas Valley | 6,321 | 10.0 | 10.0 | 10.0 | 48.9 | 10.0 | 7.0 | 10.0 |
| Middle Los Pinos River | 15,323 | 45.0 | 45.0 | 45.0 | 83.7 | 45.0 | 45.0 | 42.7 |
| Stollsteimer Creek | 2,045 | 33.3 | 29.2 | 7.2 | 38.6 | 33.3 | 0.0 | 0.0 |
| Total for Project Area | 125,342 | 672.0 | 617.0 | 475.0 | 1,158.0 | 465.0 | 473.0 | 244.0 |

Totals for long-term disturbance include acreages of disturbance predicted from windows for yet-undetermined road locations.

### Table 3–21 Long-Term Total Disturbance (Proposed) in WIZ

| | Acres in | Alternative (acres) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Watersheds | Watershed | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Beaver Creek | 28,063 | 8.7 | 11.0 | 8.3 | 26.6 | 8.4 | 13.1 | 8.3 |
| Lower Florida River | 21,729 | 3.8 | 3.8 | 3.8 | 9.0 | 3.8 | 3.8 | 1.8 |
| Lower Los Pinos River | 28,557 | 5.7 | 6.6 | 3.7 | 23.4 | 5.7 | 11.0 | 3.5 |
| Lower Piedra River | 23,304 | 35.3 | 32.7 | 14.2 | 37.1 | 20.1 | 28.8 | 15.2 |
| Middle Animas Valley | 6,321 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Middle Los Pinos River | 15,323 | 5.3 | 5.3 | 5.3 | 8.8 | 5.3 | 5.3 | 5.3 |
| Stollsteimer Creek | 2,045 | 3.2 | 3.5 | 4.6 | 5.0 | 3.2 | 0.0 | 0.0 |
| Total for Project Area | 125,342 | 62 | 63 | 40 | 110 | 46 | 62 | 34 |

Totals for long-term disturbance include acreages of disturbance predicted from windows for yet-undetermined road locations.

**Table 3–22 Long-Term Disturbance (Proposed) in WIZ as a Percentage of the Total Long-Term Disturbance**

| | Acres in | Alternative (percent) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Watersheds | Watershed | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Beaver Creek | 28,063 | 8.9 | 11.7 | 9.2 | 9.8 | 11.4 | 13.6 | 22.1 |
| Lower Florida River | 21,729 | 10.5 | 10.5 | 10.5 | 9.7 | 10.5 | 10.5 | 5.9 |
| Lower Los Pinos River | 28,557 | 4.2 | 5.0 | 3.4 | 9.1 | 5.3 | 8.2 | 5.9 |
| Lower Piedra River | 23,304 | 11.3 | 12.1 | 8.0 | 10.1 | 12.6 | 18.6 | 23.4 |
| Middle Animas Valley | 6,321 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Middle Los Pinos River | 15,323 | 11.7 | 11.7 | 11.7 | 10.5 | 11.7 | 11.7 | 12.4 |
| Stollsteimer Creek | 2,045 | 9.6 | 12.1 | 63.6 | 12.8 | 9.6 | 0.0 | 100.0 |
| Total for Project Area | 125,342 | 9.2 | 10.2 | 8.4 | 9.5 | 9.9 | 13.1 | 13.9 |

Totals for long-term disturbance include acreages of disturbance predicted from windows for yet undetermined road locations.

Table 3–23 through Table 3–26 summarize road density, road construction on steep slopes, proximity of new roads to the water influence zone (WIZ) and the estimated number of new stream crossings by roads.

Within each alternative, there are two levels of location detail. There are 56 access roads and well locations where roads and well pads have been staked and the exact location of the facilities are known. Within these staked locations, siting adjustments have been made to avoid sensitive environmental conditions where feasible. The non-staked locations have not been field verified, and will not until the companies submit APDs for the locations. These non-staked locations present conceptual approximations of the best facility location based upon quad mapping and the application of well spacing rules. During the onsites, well locations are adjusted to best avoid environmental hazards, and exception locations can be granted that move wells out of the spacing windows for such purpose. We have projected environmental consequences based on mapped locations, but condition the results on the assumption that many of the areas of concern can be avoided through careful road and well siting and utilization of engineering designs that reduce hazardous impacts.

**Table 3–23 Road Density (Proposed) by Watershed for All Alternatives**

| | Alternative (mi/mi$^2$) | | | | | | |
|---|---|---|---|---|---|---|---|
| Watershed | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Beaver Creek | 0.34 | 0.22 | 0.19 | 1.07 | 0.25 | 0.43 | 0.11 |
| Lower Florida River | 0.13 | 0.13 | 0.13 | 0.38 | 0.13 | 0.13 | 0.13 |
| Lower Los Pinos River | 0.47 | 0.39 | 0.32 | 0.98 | 0.37 | 0.53 | 0.18 |
| Lower Piedra River | 1.79 | 1.41 | 0.77 | 2.07 | 0.90 | 1.02 | 0.42 |
| Middle Animas Valley | 0.10 | 0.10 | 0.10 | 0.70 | 0.10 | 0.10 | 0.10 |
| Middle Los Pinos River | 0.23 | 0.23 | 0.23 | 0.46 | 0.23 | 0.23 | 0.23 |
| Stollsteimer Creek | 1.89 | 1.46 | 0.12 | 2.13 | 1.89 | 0.00 | 0.00 |
| Total | 0.60 | 0.48 | 0.32 | 1.04 | 0.40 | 0.46 | 0.20 |

Road density under Alternative 1 determined from road network analyzed in roads analysis (FS 2003b). Road density under Alternatives 2 through 5 determined using centroid methodology (If center of well pad falls within WIZ, then it was assumed that the length of the access road also fell within the WIZ.)

**Table 3–24 Miles of Road (Proposed) on Slopes Greater Than 40 Percent**

| | Alternative (mi) | | | | | | |
|---|---|---|---|---|---|---|---|
| Watershed | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Beaver Creek | 0.45 | 0.35 | 0.35 | 7.45 | 0.01 | 1.91 | 0.00 |
| Lower Florida River | 0.00 | 0.00 | 0.00 | 1.83 | 0.00 | 0.25 | 0.25 |
| Lower Los Pinos River | 1.69 | 1.64 | 0.67 | 6.19 | 0.43 | 1.07 | 0.25 |
| Lower Piedra River | 9.21 | 6.75 | 3.60 | 10.96 | 2.50 | 4.24 | 0.84 |
| Middle Animas Valley | 0.00 | 0.00 | 0.00 | 1.41 | 0.00 | 0.00 | 0.00 |
| Middle Los Pinos River | 0.58 | 0.58 | 0.58 | 1.58 | 0.58 | 0.58 | 0.50 |
| Stollsteimer Creek | 2.14 | 1.71 | 0.00 | 2.14 | 2.14 | 0.00 | 0.00 |
| Total | 14.07 | 11.03 | 5.20 | 31.56 | 5.66 | 8.05 | 1.84 |

Road density under Alternative 1 determined from road network analyzed in roads analysis (FS 2003b). Road density under Alternatives 2-5 determined using centroid methodology (If center of well pad falls within WIZ, then it was assumed that the length of the access road also fell within the WIZ.)

**Table 3–25 Miles of Road (Proposed) in WIZ for All Alternatives**

| | Alternative (mi) | | | | | | |
|---|---|---|---|---|---|---|---|
| Watershed | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Beaver Creek | 0.89 | 0.98 | 0.75 | 4.14 | 0.80 | 2.01 | 0.75 |
| Lower Florida River | 0.58 | 0.58 | 0.58 | 1.33 | 0.58 | 0.58 | 0.25 |
| Lower Los Pinos River | 1.22 | 0.87 | 0.58 | 4.72 | 1.22 | 2.00 | 0.50 |
| Lower Piedra River | 7.38 | 6.45 | 4.31 | 7.63 | 4.66 | 6.84 | 3.33 |
| Middle Animas Valley | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Middle Los Pinos River | 0.75 | 0.75 | 0.75 | 1.25 | 0.75 | 0.75 | 0.75 |
| Stollsteimer Creek | 0.73 | 0.49 | 0.20 | 0.98 | 0.72 | 0.00 | 0.01 |
| Total | 11.55 | 10.12 | 7.17 | 20.05 | 8.73 | 12.18 | 5.59 |

Road density under Alternative 1 determined from road network analyzed in roads analysis (FS 2003b). Road density under Alternatives 2-5 determined using centroid methodology (If center of well pad falls within WIZ, then it was assumed that the length of the access road also fell within the WIZ.)

The total number of stream crossings was calculated as follows: The total number of new road construction miles for the Project Area by alternative is known. For existing roads and trails in the analysis area, there is an average of 1.73 stream crossings per linear mile. If this factor is applied to the number of miles of new road for each alternative, an estimate can be made of total number of new stream crossings. This estimate was used to present a comparison of relative risk to aquatic resources by alternative.

**Table 3–26 Stream Crossings Estimate**

| | Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| Watershed | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Beaver Creek | 25.9 | 16.7 | 14.7 | 80.8 | 18.8 | 32.6 | 8.2 |
| Lower Florida River | 7.9 | 7.9 | 7.9 | 22.2 | 7.9 | 7.9 | 7.4 |
| Middle Los Pinos River | 9.7 | 9.7 | 9.7 | 19.2 | 9.7 | 9.7 | 9.5 |
| Lower Los Pinos River | 36.3 | 30.0 | 24.8 | 75.5 | 28.8 | 40.6 | 13.8 |
| Lower Piedra River | 112.8 | 89.0 | 48.4 | 130.1 | 56.9 | 64.1 | 26.7 |
| Stollsteimer Creek | 10.4 | 8.1 | 0.7 | 11.7 | 10.4 | 0.0 | 0.0 |
| Middle Animas Valley | 1.7 | 1.7 | 1.7 | 11.9 | 1.7 | 1.7 | 1.7 |
| Total | 205 | 163 | 108 | 351 | 134 | 157 | 67 |

Road density under Alternative 1 determined from road network analyzed in roads analysis (FS 2003b). Road density under Alternatives 2-5 determined using centroid methodology (If center of well pad falls within WIZ, then it was assumed that the length of the access road also fell within the WIZ.)

**NOTE: Stream Crossings” are an estimate of new road intersections with intermittent drainages using a Water Quality Risk Index**

The following discussion documents the potential impacts of the alternatives in the seven major analysis watersheds. The sedimentation impacts described below may affect fisheries. Appendix J, pages J–31 to J–38 presents a detailed analysis of potential aquatic species impacts.

## 3.6.3.3 Beaver Creek Watershed

The Beaver Creek analysis has been divided into sub-watersheds to organize the environmental consequences discussion. This area previously experienced a flux of CBM development in the early 1990s. Land ownership is a mixture of national forest and private land in-holdings.

### *3.6.3.3.1 Northern and middle section of Beaver Creek and Sauls Creek*

The northern and middle sections of Beaver Creek are heavily developed by a State highway, access roads, well pads, agricultural clearing, and grazing. Beaver and Sauls Creek both have perennial flow supporting riparian vegetation. Steep, dissected hill slopes and erosive soils are present along sections of Beaver and Sauls Creek. Additionally, there is a moderate level of agricultural activity near the Beaver Creek and Sauls Creek confluence. Sauls Creek watershed is moderately developed with well pads and roads. An access road follows the Creek and frequently enters the water influence zone (WIZ) over a stretch of 3 to 4 miles.

#### *Beaver Creek*

Alternatives 1, 1A, 1B, 3, 4, and 5 would result in more surface disturbance and increased erosion in the WIZ throughout the Beaver Creek watershed. Although the existing road network in this densely developed area would provide access to the majority of the proposed wells, a moderate amount of new road construction would be required in the northern section. One compressor station would be located within the WIZ under all alternatives. Large sediment yield increases and subsequent channel adjustments would occur under all alternatives. The objective of well siting would be to avoid the WIZ to reduce these potential impacts.

Alternative 2 would result in a large amount of road and well construction within the WIZ in the northern section of the Beaver Creek watershed. The risk is high for sediment delivery to impact Beaver Creek and tributaries, floodplains, and overall watershed condition.

#### Sauls Creek

Minimal development would occur along the lower and middle reaches of Sauls Creek watershed under all alternatives. Therefore, the risk is low for sediment delivery from development to impact the middle and lower reaches of Sauls Creek. However, a compressor station located on pre-existing landslide deposits would present a risk of triggering further mass failure and delivering sediment the lower reaches of Sauls Creek. The compressor station would have to be moved or the pad geotechnically engineered to reduce the potential for mass failure at the general location.

A moderate amount of development would occur in the upper reaches of Sauls Creek under Alternatives 1, 1A, 1B, and 3. Alternatives 1 and 3 would require more roads than Alternatives 1A and 1B, which would use the existing road system to access proposed well pads. However, more acreage of surface disturbance per well pad would occur with Alternatives 1A and 1B than Alternatives 1 or 3 due to the use of drilling methods that require larger well pads. An increase in erosion and sediment delivery to the upper reaches of Sauls Creek would likely result from all four alternatives.

Alternative 2 has several well windows located within the WIZ in the headwaters of Sauls Creek. Steep slopes, dissected hillslopes, and highly erosive soils exist along this section of Sauls Creek. If the wells could not be effectively sited out of the WIZ during field review, then new construction would increase erosion, sediment delivery, and floodplain modifications would highly impact Sauls Creek.

Under Alternatives 4 and 5, one well is proposed throughout the entire Sauls Creek sub-watershed and an existing road provides access to this well site. Therefore, the risk is low for sediment delivery to impact Sauls Creek.

### 3.6.3.3.2 Lange Canyon

Lange Canyon is an intermittent stream that supports riparian vegetation. The upper watershed is undeveloped. The lower watershed contains one road. Steep slopes and erosive soils exist in both the upper and lower reaches of Lange Canyon.

Alternatives 1, 1A, and 2, would require constructing a pipeline in a tributary to Lange Canyon within the WIZ and on steep (>40 percent), erosive slopes and old landslide deposits, creating a high likelihood for mass slope failure and large quantities of sediment to enter Lange Canyon Creek. To address this potential impact, geotechnical construction design would be utilized and micro-tunneling of portions of the pipeline explored to reduce surface impacts.

Alternative 2 would require road construction along the drainage divide between Lange Canyon headwaters and Lower Piedra watershed. Steep slopes and erosive soils exist along this section of the divide. The risk is high for sediment delivery and slope failure to impact this section of Lange Canyon. Again, geotechnical road designs would be utilized.

Alternative 4 would require constructing sections of a proposed road along steep and erosive slopes in Lange Canyon.

Minimal development would occur in Lange Canyon under Alternatives 1B and 3, and no new development would occur under Alternative 5. Therefore, the impacts to Lange Canyon would be low and none, respectively, under these two alternatives.

#### *3.6.3.3.3 Lower Beaver Creek watershed: Crowbar Creek and Armstrong Canyon*

Existing development in Crowbar Creek and Armstrong Canyon consists of a low level of agricultural activity in the lower reaches of both drainages. Armstrong Canyon is an intermittent stream that supports riparian vegetation, while Crowbar Creek is ephemeral. Both drainages are incised into highly erosive soils. Steep and dissected hillsides exist along sections of the channel in Crowbar Canyon. Steep slopes (>40 percent) and erosive soils exist along the drainage divide of Armstrong Canyon. The valley floor is wide and vegetative cover is sparse in the lower reaches of Crowbar and Armstrong Canyon.

Under Alternatives 1, 1A, 1B, 3, 4, 5, a number of well windows exist where well pad development would occur within the Crowbar Creek WIZ, and one window in the Armstrong Canyon WIZ. Construction activities would have significant watershed impacts to Crowbar Canyon. Well pad relocation and exception locations would be fully analyzed to avoid WIZ impacts.

Alternative 2 would result in high road and well pad densities within the WIZ of both Crowbar and Armstrong Creeks. Additionally, some well pads and roads are proposed to be built on old landslide deposits unless exceptions to spacing orders are feasible. Significant watershed impacts to both Crowbar Creek and Armstrong Canyon would be expected due to the magnitude of development. Floodplain modifications and water quality impacts would likely occur.

Alternatives 1, 1A, 1B, and 2, would require a road, well pads, and compressor station constructed along the drainage divide between Armstrong Canyon and the Piedra River watershed. Sections of the road would traverse steep slopes and erosive soils, creating a high likelihood for mass slope failure and sediment delivery to watershed streams. Careful geotechnical road design would be required to reduce the probability of slope failure.

Alternative 4 would require one road constructed along and across Long and Trail Canyon tributaries to Armstrong Canyon, and another road within Armstrong Canyon itself. Sections of the road would traverse steep, dissected, erosive slopes and through pre-existing landslide deposits. The proposed Armstrong Canyon road would traverse steep, dissected, erosive slopes and through landslide deposits. Some of the well pads accessed by these roads would be located within the WIZ and on very erosive soils. Sediment yield increases and potential channel changes would occur due to the locations of these roads and well pads.

#### 3.6.3.3.4 Summary

All alternatives would result in surface disturbance and increased erosion in the WIZ throughout the Beaver Creek watershed. Existing estimated soil loss from CBM development in the Beaver Creek watershed is 3,003 tons/year, which is among the highest of the seven analysis watersheds. Soil losses for Alternative 2 would increase short-term and long-term to an estimated maximum total of 6,669 tons/year and 5,460 tons/year, respectively. Alternative 5 would have the lowest changes to short- and long-term annual soil loss resulting in 3,494 tons/year and 3,340 tons/year, respectively. Surface impacts would be greatest along Beaver Creek, reaches of Sauls Creek, Crow Creek, and Armstrong and Lange Canyon.

Road construction throughout the watershed would range from a high of 47 miles for Alternative 2, to a low of 4.75 miles for Alternative 5. Alternative 2 road construction would total 4.14 miles within the WIZ and 7.45 miles constructed on slopes greater than 40 percent. Alternative 2 would result the largest overall negative watershed health and water quality impact. Mass failures could result for road construction and reach streams in Lange and Armstrong Canyon and Sauls Creek sub-watersheds. Sediment delivery due these slope failures could present a significant impact to these sub-watersheds. Geotechnical engineered roads would be utilized. However, the actual probability of mass-failure would not be known until field siting and design investigation were completed.

### 3.6.3.4 Middle Los Pinos River Watershed

The entire main stem Los Pinos River in this 4th level watershed is highly developed by roads, agriculture, gravel mining, grazing, scattered homes, and well pads. Large impacts from gravel mining, roads, and agriculture occur in the WIZ along the lower portion of the Los Pinos. Heavy agricultural use exists in the floodplain along the entire main stem. The main stem of Los Pinos is a perennial stream with developed floodplains and established mature riparian vegetation. Additional CBM development would occur on private land within this watershed

#### 3.6.3.4.1 Main Stem of Middle Los Pinos River

All alternatives, with the exception of Alternative 2 and 5 are identical in disturbance due to development on private and state land ownership. All alternatives would result in surface disturbance and increased erosion on private land in the WIZ throughout the main stem of Los Pinos River. Currently, a high percentage of development exists within the WIZ in the lower reaches of the Los Pinos River. Additionally, three well windows in the WIZ and 3 well windows in the floodplain along the middle and lower reaches suggests future road and well pad construction would occur within the WIZ and floodplain, unless exception well locations prove feasible during well siting. Well siting out of the WIZ and floodplain could avoid these impacts. Additional development within the WIZ would significantly impact this section of the watershed.

Alternative 2 would result in an additional 5 acres in short-term and 3.5 acres of long-term potential disturbance within the WIZ when compared to the other alternatives.

Alternative 5 is nearly identical to Alternative 1, 1A, 1B, 3, and 4, though it has 2 less well sites, which accounts for 3.5 less acres of disturbance.

For all alternatives, riparian vegetation and floodplains would be highly impacted in the lower and middle reaches of the Los Pinos River and moderately impacted in the upper reach due to road and well construction locations. Additionally, sediment yield increases and channel changes would occur along the entire main stem Los Pinos River due to the existing watershed impacts and the location of well windows in proximity to streams. To most effectively mitigate these impacts, wells should sited outside of the WIZ.

#### 3.6.3.4.2 Wallace Gulch and northern tributaries

Wallace Gulch is an intermittent stream supporting riparian vegetation. Steep, dissected hill slopes and erosive soils exist along sections of Wallace Gulch. Wallace Gulch is moderately developed by well pads, roads, and agricultural use. Heavy agricultural use and a few well pads exist in, or within proximity to the WIZ and along the floodplain. A high level of disturbance exists along and around the ephemeral northern tributaries draining into Wallace Gulch. These areas of high disturbance include well pads, a large subdivision, and county roads.

Surface disturbance and increased erosion in the WIZ in the upper and lower most reach of Wallace Gulch would occur under all alternatives. Although the majority of proposed wells are located to the north of Wallace Gulch, the construction of 3 well pads in the WIZ along the upper and lower reaches of Wallace Gulch under all alternatives would increase the level of impact to this watershed.

Alternative 2 would result in a significant increase in road and well pad construction to the north of Wallace Gulch. Currently, riparian vegetation and floodplains along the upper and lower reaches are heavily impacted by agricultural use and well pads. Therefore, additional construction would increase the level of impact. Sediment yield increases and potential channel changes would occur in the upper and lower reaches of Wallace Gulch.

#### 3.6.3.4.3 Bear Creek

Bear Creek is a perennial stream. This section of the Creek supports riparian vegetation that includes willows and cottonwood trees. Steep, dissected hill slopes, and erosive soils exist on both sides of the Creek. Minimal development (agricultural use and roads) exists in this section of the Creek.

The alternatives would not result in additional disturbance within the Bear Creek watershed.

#### 3.6.3.4.4 Summary

Additional CBM development within the WIZ would not occur on Federal lands. Increased impacts to the WIZ would occur in the middle and lower reach of Los

Pinos River and the upper and lower reach of Wallace Gulch due to CBM development on other jurisdictions. Soil erosion within the WIZ would be expected to reach surface drainages, even with the implementation of mitigation measures. The greatest potential for soil loss would occur along the lower reach of the Los Pinos River drainage and along Wallace Gulch. Significant impacts would occur in riparian areas in the middle and lower reaches of Los Pinos, and increased impacts would occur in floodplains along the upper reach of the Los Pinos, and upper and lower reaches of Wallace Gulch. Existing estimated soil loss due to CBM development in the Middle Los Pinos watershed is 1,217 tons/year. Soil losses for Alternative 2 would increase short-term and long-term to an estimated maximum total of 1,851 tons/year and 1,654 tons/year, respectively. Alternative 5 would have the lowest changes to short- and long-term annual soil loss resulting in 1,539 tons/year and 1,441 tons/year, respectively.

Road construction throughout the watershed ranges from 11 miles for Alternative 2, to approximately 5 miles for all other alternatives. Alternative 2 has the highest level of proposed new road and well construction, which includes 1.25 miles within the WIZ and 1.58 miles constructed on slopes greater than 40 percent. Alternative 2 would have the largest overall negative impacts to watershed health and water quality followed by the other alternatives which would have lower effect.

## 3.6.3.5 Stollsteimer Creek Watershed

Stollsteimer Creek has perennial flow supporting riparian vegetation. Steep, dissected hill slopes, sections of sparse vegetative cover and erosive soils exist along both sides of this creek. A minimal level of development exists within the analysis area, which includes roads and agricultural activity. Wells constructed in this watershed would be on national forest system land.

### 3.6.3.5.1 Stollsteimer Creek

Alternatives 1, 1A, 1B, 3, 4, and 5 would not impact Stollsteimer Creek.

Alternative 2 involves development of one well potentially within the WIZ of Stollsteimer Creek, and a few other well windows just beyond the WIZ. An increase in surface disturbance and increased erosion in these areas would have minor effect on riparian areas and floodplains.

### 3.6.3.5.2 Unnamed side tributary to Stollsteimer Creek

Steep, dissected hillslopes and erosive soils exist along an unnamed side tributary. No development currently exists within this tributary.

Alternatives 1, 2, and 3 would potentially result in construction of one well and one compressor station within the WIZ of the tributary. In addition, sections of a proposed well access road would be located in the WIZ and traverse steep slopes and erosive soils.

Alternative 1A would require one compressor station and one well pad within, or within proximity of the WIZ of this tributary. Sections of the well access road impact the WIZ and traverse steep slopes and erosive soils. An increase in surface disturbance and erosion would occur due to the location of road and well sites. Riparian areas and floodplains would be directly, but moderately impacted. However, sediment yields would increase and potential channel changes may occur on this tributary, and possibly Stollsteimer Creek, due to the conceptual locations of proposed roads and well pads.

Under Alternative 1B, riparian areas and floodplains would be impacted due to the construction of one well pad within the WIZ. However, surface disturbance and increased erosion would be minimal due to the low level of development under this alternative.

Alternatives 4 and 5 would not impact the tributary to Stollsteimer Creek.

Under all alternatives, roads and well pads would be sited to avoid WIZ impacts to the extent practical.

#### *3.6.3.5.3 Deep Canyon*

Deep Canyon is largely undeveloped with the exception of one Forest Service low standard road located in a narrow valley bottom. An ephemeral channel with steep, dissected hillslopes and erosive soils exists on both sides of this channel. This canyon and surrounding watershed has a high potential for wind and water erosion.

Alternatives 1, 2, and 3 would increase surface disturbance and erosion due to the potential construction of two well pads and a section of proposed pipeline within the WIZ. Additional sediment production and channel changes would occur due to construction of a road accessing five well sites located along steep slopes and erosive soils, and a pipeline located on highly erosive, dissected, steep slopes.

Alternative 1A impacts would result from construction of one well pad and a section of proposed pipeline the WIZ. The proposed pipeline and road would cross highly erosive, dissected, steep slopes. Sediment yield and channel changes would increase due to the sensitive locations of pipeline, roads, and well pads.

Alternative 1B would involve development of one well pad within the WIZ. No additional road building or pipeline construction would occur. Surface disturbance and increased erosion would occur within the WIZ. However, sediment production and channel changes would be minimal over the long term due to the low level of development.

#### *3.6.3.5.4 Summary*

The direct impacts on Stollsteimer Creek would be moderate for all action alternatives. However, due to the concentration and location of development for Alternatives 1, 1A, 2, and 3 in the unnamed tributary and Deep Canyon, the risk of sediment yield and subsequent channel changes would increase in Stollsteimer Creek. Impacts would be greatest in the unnamed tributary and Deep Canyon sub-watersheds. Under Alternatives 1, 1A, 2, and 3, the conceptual pipeline and road locations in Deep Canyon would occur on highly erosive, dissected, steep slopes. Sediment yield and channel changes would increase due to the sensitive locations of the pipeline, roads and well pads. Existing estimated soil loss from CBM development in the Stollsteimer watershed is 91 tons/year. Soil losses for

Alternative 2 would increase short-term and long-term to an estimated maximum total 884 tons/year and 598 tons/year, respectively. Alternatives 4 and 5 would have the smallest increases in annual soil loss resulting in 91 tons/year total, the same as the existing condition.

Road construction in the WIZ throughout this watershed is low, ranging from a total of 0.98 miles for Alternative 2, to no miles for Alternatives 4 and 5. Eroded soils within the WIZ would be expected to reach surface drainages. New construction on steep, erodible soils ranges from 2.14 miles for Alternatives 1, 2, and 3 to 0 miles for Alternatives 1b, 4 and 5.

## 3.6.3.6 Lower Los Pinos Watershed

This large watershed is bisected by the analysis area into a western and eastern portion. CBM development proposals, existing watershed condition, and associated development effects differ in the west Lower Los Pinos compared to the east. The streams in the west include Dry Creek, Homer Canyon, Holman Canyon, and Hartman Canyon. All the sub-watersheds in the west Los Pinos have experienced CBM development and are primarily private lands. Dry Creek and Homer Canyon have intermittent streams that support riparian vegetation. Spring Creek and Ute Creek, both intermittent streams that support scattered riparian vegetation, are in the eastern portion of the watershed. The eastern sub-watersheds range from low levels of existing development to no development and are primarily federal lands.

### *3.6.3.6.1 West Los Pinos Watershed*

Within the western part of the watershed, similar CBM development impacts are expected for all alternatives due to development on private and state lands. High levels of road and well pad development would occur in the Dry Creek sub-watershed. Road and well pad construction occurring in the WIZ would likely modify floodplains, impact riparian vegetation, and increase erosion and sediment delivery to Dry Creek. All development in the WIZ would occur on private land in Dry Creek. Impacts in Holman Canyon and Hartman Canyon would result from construction on erosive soils and potentially within the WIZ. All alternatives would likely result in increased erosion and increased sediment delivery to these streams. Impacts to floodplains would likely occur.

A relatively low level of development is proposed within Homer Canyon. There is one well window on highly erosive soils which would cause localized erosion. Overall impacts to the watershed and stream are expected to be low with all alternatives.

### *3.6.3.6.2 East Los Pinos Watershed,*

Alternatives 1, 1A, and 1B would result in potentially high watershed impacts. The majority of new road construction would be concentrated in the Spring Creek area of the east Los Pinos watershed. There would be minor development within the tributaries of Ute Creek, Ritter, Reservoir, and Green Canyons. Several miles of road would be constructed in the upper watershed and would traverse extremely steep, narrow ridgelines with high landslide and erosion potential. Many well pad locations would reside on very steep, unstable and erosive ridgelines and hillsides and may require cut and fill construction. Impacts within the upper watershed are anticipated to be high in some locations. There is high risk for sediment delivery and mass wasting to impact the stream, floodplains and overall watershed condition. The lower watershed has more gentle terrain, but highly erosive soils. There would be several miles of road constructed in the WIZ and two wells located in the WIZ.

Alternative 2 impacts would be greater than those projected for Alternative 1, 1A, and 1B. In addition to the impacts described above, Alternative 2 would involve extensively developing the un-roaded tributaries to Ute Creek; Ritter, Reservoir, and Green Canyons. New construction in these canyons greatly increase total road density, the number of stream crossings, road construction on highly erosive soils, and construction of facilities in the WIZ. There would be direct impacts on stream channels, and floodplain modification would occur. Increased sedimentation to Ute Creek and its three tributaries would likely result in considerable negative impacts to channel stability and channel function. Implementation of watershed best management practices, engineered road design and well siting would partially mitigate this impact, but watershed impacts would still be considered high.

Alternatives 3, 4, and 5 would result in lower watershed impacts than Alternatives 1 and 2. These alternatives do not involve development of the steep, unstable lands. Mass failure risk would be largely avoided. Road densities would double in the lower Spring Creek watershed increasing overall sediment production in the watershed. Most of the new roads in this area would avoid erosive soils and be located away from streams. For these reasons, mitigation measures should be effective in reducing sediment production and delivery to streams.

#### *3.6.3.6.3 Summary*

Overall total road densities (existing and proposed) would range from 1.83 mi/mi$^2$ in Alternative 5 to 2.63 mi/mi$^2$ in Alternative 2. Between 8 miles of new road would be built for Alternative 5 and 43.7 miles of new road for Alternative 2.

Differences between alternatives are most pronounced in the east part of the watershed. Alternative 2 would have the greatest overall impact on watersheds, stream conditions, and water quality. A total of 4.7 miles of road would be constructed in the WIZ (and potentially floodplains and riparian areas) and a number of well pads would be potentially located in floodplains. Although not quantified, mass failure risk is expected to be highest under Alternative 2.

Alternative 2 surface erosion would be highest with 4,927 tons/year of new sediment generated in the short-term resulting in a total 9,854 tons of erosion per year. Sediment quantities generated from potential mass failures are not included in the surface erosion estimates.

### 3.6.3.7 Middle Animas Valley Watershed

The analysis area covers a relatively small portion of a large watershed. It includes a portion of the Animas River and two intermittent tributaries, Wilson Gulch and Big Canyon. The relatively undeveloped Big Canyon is primarily in BLM land ownership and supports riparian vegetation. Wilson Gulch is moderately to highly developed by agricultural fields, roads, CBM wells, homes, and businesses.

The proposed activities in the Middle Animas Valley are the same for Alternatives 1, 1A, 1B, 3, 4, and 5. The level of new CBM development is low, with only 6 new wells proposed. This development would require no new road construction in the WIZ and no new roads on steep slopes. Most of the development would occur on gentle or flat terrain. Watershed impacts are expected to be low with this alternative.

CBM well development would be more extensive under Alternative 2_compared to the other alternatives. No new road construction would occur in the WIZ; however, 1.4 miles of new road would traverse very steep slopes and cross canyon-like topography. A higher level of construction would occur in steep, dissected terrain that is currently undeveloped. Wells would be developed in the steep upper drainages of Big Canyon. Construction in the WIZ, and cut and fill construction in the steep, dissected terrain of this area would likely cause erosion that would directly impact Big Canyon and would easily transport to the Animas River.

### 3.6.3.8 Florida River Watershed

With the exception of the Florida River, streams in this watershed are intermittent. The Florida River is currently in poor condition within the analysis area. Recent large-scale sedimentation and flooding after the Missionary Ridge Fire has degraded Florida River water quality and channel conditions (FS 2002b). Severe water shortages due to drought and diversions have also negatively impacted the aquatic habitat. The impacts, combined, have recently eliminated Florida River fish populations in some river reaches within the analysis area. Lower development has occurred in the N/NW portion of the analysis area watershed due to steep, dissected slopes and erosive soils. The south part of watershed has gentle topography and has varied development including homes, agriculture, roads, and CBM wells.

Road construction in floodplains and riparian areas would be moderately high in this watershed under Alternatives 1, 1A, 1B, 3, 4, and 5, ranging from 0.25 miles for Alternative 5 to 0.58 miles for the other alternatives. New construction on erosive soils would occur. Erosion and soil loss within the WIZ would be expected to reach surface drainages, even with mitigation measures. Many well windows are currently planned within the WIZ. Wells would be sited outside of this zone where feasible. The total number of new road miles across the entire watershed ranges from 4.3 miles in Alternative 5 to 4.5 for Alternatives 1, 1A, 1B, 3, and 4.

Alternative 2 would increase the level of development in the N/NW part of the watershed where the land is steeper, dissected by many streams, erosive and relatively undeveloped. The other alternatives largely avoid these areas. The Alternative 2, 1.3 miles of road constructed in WIZ is greater than the other alternatives as is the 12.8 miles of new access road that would be required by the Alternative.

#### 3.6.3.8.1 Summary

The Florida River is in poor condition due to uncharacteristically high sediment loads produced from the Missionary Ridge fire upstream of the project area and from subsequent flooding. New road construction, especially roads located in floodplains, have a moderate to high risk to produce increased sediment yield directly to intermittent streams and, potentially, to the Florida River. Existing CBM development soil losses are estimated to be 969 tons/year. The alternatives would increase soil losses by 119 tons/yr (1088 tons/year total) short-term for Alternative 5 to 373 tons/yr (1342 tons/yr total) short-term for Alternative 2. The alternatives would increase soil losses by 81 tons/yr (1050 tons/year total) long-term for Alternative 5 to 251 tons/yr (1220 tons/yr total) long-term for Alternative 2.

Alternative 2 would have the largest overall negative impact to watershed health, and water quality. Increased sediment delivery associated with all alternatives would likely prolong recovery time of aquatic habitat, water quality, and channel equilibrium in the Florida River.

### 3.6.3.9 Lower Piedra River Watershed

The Lower Piedra watershed is large and the alternatives have varied impacts depending on the watershed area assessed. For this reason, the analysis is presented by sub-watersheds to simplify discussion.

#### 3.6.3.9.1 Little Squaw, Goose, Ignacio, and Bull Creeks

The upper watershed of Little Squaw Creek is undeveloped and has a narrow valley bottom, with steep, erosive, and unstable hillsides with landslide deposits. The lower watershed has one existing road along the open, gentle valley bottom with well-developed riparian areas. Goose and Bull Creeks are undeveloped canyons with perennial flow and riparian vegetation. Ignacio Creek is an intermittent stream, undeveloped in the upper watershed. The lower watershed has several roads.

Alternatives 1, 2, and 4 would modify a high percentage of the WIZ, riparian areas, and floodplains due to new road construction in these four watersheds. Because of narrow canyon corridors, road construction may also require fill material to be built into floodplains or channels. New road construction would also traverse areas of steep, dissected slopes with erosive soils. Additionally, high overall road densities would result from these alternatives. Because of the construction locations, sediment yield increases, floodplain modification, water quality impacts, and negative stream channel changes are likely.

##### Ignacio Creek

Impacts to the Ignacio Creek watershed are expected to be high. A large number of new road/stream crossings, high road density, and some construction in WIZ are projected within the lower Ignacio Creek watershed. The objective of well siting during the staking process would be to avoid the WIZ where possible. Proposed roads would cross several dissected slopes with erosive, bare soils. Sediment delivery to channels would increase significantly. The upper watershed would have several miles of road constructed on extremely steep, narrow ridgelines with areas of high landslide and erosion potential in many places. Well pad locations would require cut and fill on very steep, often unstable and erosive ridgelines and side slopes. A pipeline in the Sheep Canyon tributary would be located in a steep, narrow valley bottom with erosive, unstable soils in the WIZ. Impacts in the upper watershed are anticipated to be extremely high in some locations. There would be high risk for sediment delivery, slope failures, and mass wasting impacts to the stream and watershed under Alternatives 1, 2, and 4.

Alternative 1A and 1B impacts are also anticipated to be high in Ignacio Creek. A high number of road crossings, high road density, and some construction in the WIZ are proposed within lower watershed. Roads would cross several dissected slopes with erosive, bare soils. Sediment delivery to channels would increase significantly. Within the upper watershed there would be several miles of road constructed on extremely steep, narrow ridgelines that have high landslide and erosion potential in many places. A number of well pad locations would require cut and fill on very steep, potentially unstable and erosive ridgelines and side slopes. Impacts would be slightly lower than Alternatives 1 and 2 because there would be no new pipeline in Sheep Creek and approximately 2 miles less road construction on unstable ridgelines

There is no planned activity and no watershed impacts for Alternatives 3 and 5 in Ignacio Creek.

### *Little Squaw Creek*

Alternatives 1 and 2 would require pipeline construction in the canyon headwater areas of Little Squaw Creek. Pipeline construction would impact steep slopes with high hazard soils and high landslide potential. Road and pipeline construction would result in increased sedimentation and localized areas of moderate to high mass failure. Many of the conceptual well pad locations are within, or within proximity of the WIZ; the objective would be to avoid these areas during well siting.

Alternative 4road construction would be limited to one mile, and there would be no pipeline construction in Little Squaw Creek. Thus most of the impacts described above would be avoided.

Alternative 1A would have similar impacts to Alternatives 1 and 2 within Little Squaw Creek. Although fewer road miles would be constructed, more new pipeline construction would occur and cause more disturbances over steep and dissected terrain. Any benefits realized by less road construction would be offset by additional pipeline construction.

Alternative 1B, 3, and 5 would have similar, but fewer negative effects in Little Squaw Creek compared to Alternatives 1 and 2.

### *Goose Creek*

Alternatives 1 and 2 would result in the highest impacts in Goose Creek. Alternatives 1A, 1B, 3, and 5 would have the similar, but lower watershed impacts than Alternatives 1 and 2. New roads built over steep, dissected, erosive terrain would be largely avoided. Road construction in the WIZ would still occur in Goose

Creek, which would modify floodplains, increase sediment delivery, and impact water quality.

#### Bull Creek

Alternatives 1, 1A, 2, 3, 4, and 5 would have the same impacts in Bull Creek. Large watershed impacts from high road densities would occur. Floodplain modification, water quality, and riparian impacts would likely occur.

Alternative 1B would have the highest watershed impacts in Bull Creek because it has the highest level of road construction among the alternatives. The additional road construction would occur on steep dissected slopes with erosive soils. It is anticipated that cut/fill construction on the steepest areas would be required and high erosion potential would result.

### 3.6.3.9.2 Squaw Creek, Wagon Gulch, Blind Gulch, Fosset Gulch and Turkey Creek

Fosset Gulch and Turkey Creek are perennial streams with dense riparian vegetation in places. Squaw Creek, Wagon Gulch, and Blind Gulch are small intermittent watersheds within the analysis area. Squaw Creek, Fosset Gulch, Turkey Creek, and Wagon Gulch, all have irrigated agriculture, roads, and scattered homes in the valley bottoms. Blind Gulch is largely undeveloped with one minor road in the valley.

Minor amounts of road construction would occur in the WIZ within these watersheds under Alternatives 1, 1A, 1B, 3, 4, and 5. Most new road construction in Fosset Gulch would consist of stream crossings. Overall road densities would increase substantially in all sub-watersheds. New facilities potentially constructed in the WIZ include one new well in Wagon Gulch, one new well in Turkey Creek (Alternatives 1, 2, and 3 only), one new compressor station in Blind Gulch, and 3 compressor stations in Fosset Gulch (no compressors in Fosset Gulch under Alternative 5). Facilities built in floodplains, adjacent to streams would present a high risk of direct watershed impact due to increased erosion and subsequent sediment delivery to streams, increased risk of spills into streams, and floodplain modification. Mitigation could include relocating the Fosset Gulch compressors outside the WIZ, thereby reducing impacts to the stream.

Alternative 2 would result in greater impacts to Squaw Creek and Fosset Gulch than the other alternatives due to additional road construction and additional wells that may be located in the WIZ. New roads and wells are planned within the WIZ and on steep, erosive soils within Fosset Gulch. These facilities would likely result in increased sediment delivery to streams and cause a higher degree of floodplain and riparian impacts.

### 3.6.3.9.3 Pole Creek

Upper Pole Creek watershed is undeveloped and has wet meadows and well developed riparian areas. Landslides are present on steep slopes. The lower watershed has irrigated agriculture, and roads.

Under Alternative 1, 1A, and 2, two new wells and approximately 0.5 miles of new road constructed within the WIZ would modify floodplains and riparian area and increase sediment delivery to channels. Alternatives 1B, 3, 4, 5 would have result in lower impacts than Alternative 1 due to less road construction. Under Alternative 3, 1 new well and 0.5 miles of road would be constructed in the Pole Creek WIZ.

#### 3.6.3.9.4 Summary

All action alternatives would result in high impacts to the Lower Piedra watershed. More new construction is proposed in this watershed than any other in the analysis area. Impacts would be greatest in the Ignacio, Little Squaw, Bull, and Goose Creek sub-watersheds.

Road construction in the WIZ and in floodplains and riparian areas would be very high in this watershed, ranging from a total of 7.6 miles for Alternative 2, to 3.3 miles for Alternative 5, unless these areas could be avoided during road siting. High erosion rates within the WIZ would be expected to deliver sediment to surface drainages, even with mitigation measures. Existing soil loss from CBM development is approximately 1,654 tons/year. New construction would increase surface sediment production by 940 tons/year (2,594 tons/yr total) in Alternative 5 and by 5,358 tons/year (7,012 tons/yr total) in Alternative 2. Total impacts from road construction would also be high ranging from 78 miles of new road for Alternative 2 to 15.5 miles of new road construction for Alternative 5. A detailed comparison of new construction for all alternatives is presented in Table 3–17 to Table 3–25.

Compared to any other watershed in the analysis area, more road construction on steep, unstable areas would occur in the Lower Piedra Watershed. New construction on steep, erosive soils ranges from 10.9 miles for Alternative 2 to 0.9 miles for Alternative 5. Depending on the road locations, large volumes of sediment from mass failures and surface erosion would have a moderate to high potential of reaching streams in the Ignacio and Little Squaw sub-watersheds for Alternatives 1, 2, 4, 1A, and 1B.

### 3.6.3.10 CBM Development, Irrigation Water Quality and Fugitive Dust

#### 3.6.3.10.1 Alternative 1 — Proposed Action

The quality of irrigation water conveyed in open channels could be affected in the short term if they were adjacent to or along the ROW corridor where construction of well pads, pipelines, and roads would occur. These waters could also be affected over the long term by vehicular traffic on roads with native surfaces. Facility construction and operation would reduce vegetative cover and increase emissions of fugitive dust.

Dust settling in the open channels conveying irrigation waters would increase suspended sediment loads, turbidity, and potentially other constituents that would be associated with or sorbed to the sediments. Stream segments downstream of the Project Area that provide irrigation water and that are currently impaired by sedimentation could be affected over the short term by Alternative 1, but irrigation waters are not expected to be degraded over the long term.

BMPs would include locating well pads and roads and pipeline corridors away from open channels and irrigation diversions and using dust inhibitors on the surfaces of roads that could cause emissions of fugitive dust. Dust suppression techniques would be used according to COGCC or other state or federal requirements. The CDPHE Air Pollution Control Division requires land-developing projects to prepare and implement a fugitive dust control plan. This requirement applies to land development that lasts longer than 6 months and encompasses a total area of 25 acres or more and would most likely be necessary under Alternative 1.

Roads, pipelines, or well pads constructed within or across waters of the U.S, which could include irrigation ditches or canals, would require USACE Section 404 permitting under the Clean Water Act. Drainages must exhibit a bed and bank and a definable channel with a connection to a downstream stream or river to be considered waters of the U.S. Whether permits are required would be decided on a site-specific basis at the APD level of analysis. If construction occurs within or traverses irrigation ditches or canals, it would be subject to Section 404 permitting requirements, and mitigation measures would be necessary to protect the quality of irrigation water.

#### *3.6.3.10.2 Alternative 1A through Alternative 5*

The environmental effects of the other alternatives are not expected to vary from Alternative 1, with the exception of Alternative 3, where there would be no impacts from fugitive dust in the HD Mountains Roadless Area.

### 3.6.3.11 Effects on Surface Water Flows and Associated Riparian Areas, Wetlands, Springs and Seeps

Dewatering the Fruitland Formation would intercept groundwater discharge to local rivers, thus decreasing streamflow. Dewatering the Fruitland Formation would also have the potential to dewater seeps and springs in the outcrop area.

#### *3.6.3.11.1 Alternative 1 — Proposed Action*

Dewatering the Fruitland Formation would result in long-term depletions to surface water flows by intercepting groundwater discharges to streams in the Project Area. Potential impacts to surface flows from dewatering depend primarily on the proximity of the drill sites to a river and on the pathway for groundwater discharge to the river.

Historical discharge to the combined Animas, Florida, Pine, and Piedra Rivers is 194 acre-feet/year from the Fruitland Formation (Cox et al. 2001). CBM development to date has intercepted groundwater and depleted surface flows from these drainages. As of 2001, approximately 65 acre-feet/year in surface flows was being lost to the Animas, Pine, and Florida Rivers.

Loss of surface flows from the Animas, Pine, and Florida Rivers will increase to approximately 140 acre-feet/year over the next 30 to 50 years as a result of CBM development that has occurred to date. In other words, the wells currently in production will continue to operate and deplete surface water flows independent of the new wells proposed from this project.

CBM infill wells will not increase or accelerate surface water depletions by a significant degree in the Animas and Los Pinos drainages. Infill wells may cause additional increased depletions of approximately 5 acre-feet/year in the Florida River resulting in a total loss of 13 acre-feet/year long-term.

The effect of existing development on volumes of groundwater discharge to the Piedra River is unknown; however, maximum depletions of 60 acre-feet/year from this proposed development would be expected.

The comparison of groundwater discharge with measured base flows and predicted maximum depletions in three of the aforementioned streams is shown in Table 3–27.

**Table 3–27 Comparison of Fruitland/Pictured Cliffs Discharge with Measured Base Flows**

| Stream | Measurement Location | Period of Record | Measured Baseflow (acre-feet/year) | Predicted Baseline Fruitland Discharge (acre-feet/year) | Predicted Maximum Depletion from CBM (acre-feet/year) |
|---|---|---|---|---|---|
| Animas River | Animas River near Durango | 1987–1998 | 144,793 | 66 | 66 |
| Pine River | Pine River near Bayfield | 1975–1986 | 36,198 | 61 | 61 |
| Florida River | Florida River near Durango | 1950–1960 | 7,240 | 17.5 | 13 |

Source: Cox et al. 2001

Riparian and wetland areas near the larger rivers are not likely to be affected by Alternative 1 CBM development. The depletions in surface flows are negligible when compared with baseflows in these rivers. In addition, wetland and riparian areas along the outcrop of the Fruitland Formation would be avoided during construction of CBM facilities, where possible, in accordance with BLM and FS guidelines.

Springs and seeps situated along the Fruitland and Pictured Cliffs outcrops may be affected by reduced surface flows caused by dewatering the Fruitland Formation. Potential impacts would depend on the proximity of the drill sites to these features. Areas with concentrated CBM wells could be adversely affected by reduced surface flows and subsequent drying up of springs. Spring flow may also be inhibited locally if compaction occurs during construction or production. Well construction could diminish the utility of these seeps and springs for domestic, irrigation, or stock watering supplies.

The nearest proposed well is more than ¼ mile away from the seeps and springs located along the outcrop. In accordance with BLM and FS guidelines, proposed wells would be relocated during the APD stage to avoid construction in moist areas. Site-specific monitoring of seeps and springs along the outcrop would be required to evaluate impacts from CBM development under this alternative.

Alternative 1 would remove more groundwater from the coal seams during CBM development than would be recharged. The rate of groundwater recharge would determine the rate of recovery of the produced aquifer.

The rate of recharge of the Fruitland Formation would not be affected by changes in surface flows over the life of the project. The rate of recharge depends primarily on the amount of meteoric recharge, which is highest along the outcrop, and not on leakage from streams where the alluvial aquifers are hydraulically connected. Surface water depletions would continue over the life of the project or longer, or until the Fruitland aquifer is recharged. The interaction between surface flows and the Fruitland aquifer would return to pre-CBM development conditions once the aquifer is recharged.

#### *3.6.3.11.2 Alternatives 1A through 4*

The environmental effects of Alternative 1A through Alternative 4 are not expected to vary significantly from Alternative 1. However, under Alternative 2 – Maximum development, the environmental effects would be similar to Alternative 1, but would be proportionally greater because of the increased rate of aquifer dewatering caused by additional well development.

#### *3.6.3.11.3 Alternative 5 — No Action*

Depletions to the Piedra River would not occur, so the environmental effects would be less than under Alternative 1, because CBM development would not intercept groundwater that normally discharges to this river.

### 3.6.3.12 Consumptive Water Uses, Water Rights, and CBM Well Production

There are two types of consumptive water uses associated with CBM development. First, water is needed to drill wells and build well infrastructure. Second, water is also used up in the process of extracting methane gas. Water that would normally flow from the Fruitland Formation into rivers would be intercepted, extracted, and re-injected into deeper aquifers.

The water requirements for CBM well drilling and completion and for construction of roads, pipelines, and compressor stations are summarized in Table 3–28. Water volumes were calculated as described in Chapter 2.

**Table 3–28 Well Drilling and Well Construction Water Requirements for All Alternatives**

| | Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Total Water Requirement (acre-feet) | 160 | 140 | 120 | 260 | 110 | 100 | 60 |

The water that would be lost to the Animas, Florida, Pine, and Piedra Rivers by dewatering the Fruitland Formation for all alternatives is summarized in Table 3–29, and displayed graphically in Figure 3–28.

**Table 3–29 Long-Term Maximum Water Depletions to Area Rivers Resulting from Dewatering the Fruitland Formation**

| | Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| Stream | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Animas River (depletions acre-ft/yr) | 66 | 66 | 66 | 66 | 66 | 66 | 66 |
| Florida River (depletions acre-ft/yr) | 13 | 13 | 13 | 13 | 13 | 13 | 5 |
| Piedra River (depletions acre-ft/yr) | 60 | 60 | 60 | 60 | 60 | 60 | 0 |
| Pine River (depletions acre-ft/yr) | 61 | 61 | 61 | 61 | 61 | 61 | 61 |
| Total Water Depletions (acre-feet) | 200 | 200 | 200 | 200 | 200 | 200 | 132 |

Source: Cox et al. 2001

### 3.6.3.12.1 Alternative 1 — Proposed Action

Dewatering of the Fruitland Formation is necessary to extract methane gas. Dewatering this aquifer will result in annual surface water losses of about 140 acre-feet/year from the Florida, Pine, and Animas Rivers, and 60 acre-feet/year from the Piedra River over the life of the project. Surface water losses would continue for several centuries (Cox et al. 2001). These depletions would affect existing water rights because less surface flow would be available, particularly during the irrigation season, when many of the streams in the Project Area are short of water.

Water needed to drill wells in Alternative 1 would consume approximately 160 acre-feet of water over the life of the project. The operators would purchase water from a variety of users, resulting in minor shifts in water consumption from existing uses to this project. Approximately 0.03 percent of the irrigation use in La Plata and Archuleta Counties would shift to industrial use for this project. The companies would purchase the water from current users with existing water rights. The companies would also have the option to apply for water rights for this identified use. Individual landowners would negotiate terms for the companies to purchase water from the volume allocated to the landowner.

### 3.6.3.12.2 Alternatives 1A through 5

The environmental effects of Alternative 1A through 4 with respect to dewatering the Fruitland Formation and reducing surface water flows are not expected to vary from Alternative 1. For Alternative 5, surface water depletions of the Pine, Florida, and Animas Rivers would be similar to the impacts described for Alternative 1; however, depletions in the Piedra River would be less than under Alternative 1, because CBM development would not intercept groundwater that normally discharges to this river.

Alternative 2 would result in the highest level of water consumption for drilling, followed in descending order by Alternatives 1, 1A, 1B, 3, 4 and 5 (Table 3–24). Approximately 0.03 percent of the irrigation use in La Plata and Archuleta counties would shift to industrial use to satisfy drilling needs.

## 3.6.3.13 Beneficial Use of CBM Produced Waters

### 3.6.3.13.1 Alternative 1 — Proposed Action

As of December 1998, 244 million barrels or 28,900 acre-feet of water have been produced from the Fruitland Formation (Questa 2000). Water production associated with CBM development currently varies in the Project Area. CBM wells have produced from 4 barrels per day in the eastern portion to 75 barrels a day in the western portion.

CBM wells proposed under Alternative 1 could generate from 0.2 to 3.5 acre-feet/year of produced water. This water would be available to support beneficial use, which could include irrigation, stock watering, fugitive dust control, and wildland fire fighting. The beneficial use of produced waters depends on quality, and would require additional analysis and permitting. Produced water from the Fruitland Formation is marginal to poor quality (1,000 to 10,000 mg/L of TDS), but would vary within the Project Area (Cox et al 2001).

Surface discharge of produced waters is not currently proposed, but some companies are evaluating and pilot testing discharge to surface waters. The suitability of CBM produced water for surface discharge and the limitations on use based on water quality would be established in site-specific NPDES discharge permits. Surface discharge of CBM produced waters could degrade water quality if the discharge did not adhere to the requirements in permits or the associated limitations were exceeded. Pre-treatment of the produced waters would most likely be necessary to meet the required standards. Treatment methods could include reverse osmosis, ion exchange, or a combination of both. Produced water discharged to surface drainages would be available for appropriation and diversion under SEO regulations.

Impoundments may also be constructed to treat, dispose of, or provide for beneficial use of produced waters. Impoundments constructed in upland areas in the Project Area would disperse livestock and wildlife and offer the benefit of better use of forage and reduced overgrazing and erosion. Produced water proposed for beneficial use would require an application for a well permit to be filed with the SEO that designates the type of use. Pre-treatment may be needed to amend the quality of CBM produced water to meet criteria specific to and to support the intended use.

### 3.6.3.13.2 Alternative 1A through 5

The environmental effects of Alternative 1A through 5 are not expected to vary from Alternative 1.

### 3.6.3.14 Cumulative Effects of CBM Development on Water Quality, Fugitive Dust, Surface Water Depletions, Consumptive Uses, and Water Rights (and any other issue addressed in Environmental Consequences).

Cumulative effects to surface waters include the effects of past, present, and reasonably foreseeable projects in the cumulative effects analysis area. From a watershed perspective, the cumulative effects analysis area encompasses that portion of the Upper San Juan Basin fourth-level watershed (USGS HUC 14080101) above Navajo Dam in New Mexico, and the Animas fourth-level watershed (USGS HUC 14080104), above Bloomfield, New Mexico.

Cumulative effects on water quality would result from an increase in the amount of bare ground and unpaved roads due to increased oil and gas activities within the San Juan Basin. In addition to energy development, other activities that contribute to cumulative surface water impacts in the Project Area include timber harvest and prescribed burns, off-highway vehicle (OHV) use, agriculture and grazing, sand and gravel mining, and rural and urban housing development.

The quantitative analysis of cumulative effects is limited to oil and gas development within the entire cumulative effects area. Cumulative effects to surface water resources resulting from other activities in the analysis area such as timber harvest, rural and urban housing development, and OHV use, were not quantified.

### 3.6.3.15 Surface Water Quality — Chemical Contamination as a Result of Spills Surface Water Quality — Chemical Contamination as a Result of Spills

Surface water quality in the cumulative effects area of each watershed could be degraded by accidental spills of petroleum products, produced water, or drilling fluids. Under all action alternatives, effects from accidental spills due to vehicle refueling operations, a breach in pipelines, or mishandling of hazardous material could occur throughout the cumulative effects area. The impacts associated with hazardous waste could have cumulative effects only if they were improperly handled (spilled) or left on-site. This could lead to inadvertent exposure or future spills, and if this were to occur at several sites, there would be a cumulative effect. However, cumulative impacts to water quality would be minimized if material handling requirements, federal and state water quality regulations, BMPs and mitigation measures were implemented (Appendix F).

For those well locations near surface drainages, accidental releases of drilling fluids caused by failure or an overflow of the pit, could traverse the well pad and migrate into the surface drainages. Additionally, the more well construction within the WIZ, the higher the cumulative risk would be for those spills to impact water quality. However, constructing a berm around the perimeter of the well location would significantly minimize the chances for these spills to reach those drainages. Therefore, cumulative impacts associated with accidental spills of drilling fluids or overflow of the pit are not anticipated.

Reserve pits are normally a part of a well site and are used for storage or disposal of water, drill mud, and cuttings. Pits improperly constructed can result in failure. Well locations within the WIZ have a greater chance of pit failure than those outside the WIZ due to potential flood events. During flood events, the spoils of the pit could overflow and enter into surface drainages. The cumulative risks associated with pit failure and any contaminants reaching surface drainages are high with well pad construction within the WIZ.

These short-term impacts would occur during the construction, drilling, and completion phases of well pad development. For the Project Area, the proposed well pad density inside and outside the WIZ is greatest for Alternative 2. Therefore, the cumulative impacts to water quality from these spills throughout the Project Area under Alternative 2 would be greater than the effects for all other action alternatives. In descending order, Alternatives 1 1A, 4, 3, 1B, and 5 would all have fewer cumulative effects on water quality than would Alternative 2.

### 3.6.3.16 Surface Water Quality — Physical Changes as a Result of Well Pad, Road, and Pipeline Construction

Navajo Reservoir is the downstream boundary of the surface water cumulative effects analysis area for all watersheds except the Animas and Florida Rivers. The reservoir acts as a sink to trap sediment. Because of its volume and size, it would be difficult to distinguish water quality changes in the reservoir that result from this project and all other on-going activities in the entire upper San Juan River watershed. The Animas River confluence with the San Juan River is the downstream cumulative effects boundary for the Animas and Florida Rivers.

Cumulative impacts to surface water quality that would result from well pads, roads, and pipeline construction during existing and proposed CBM development on the Southern Ute Reservation and the Farmington EIS planning area would be similar to the effects described for this project. Oil and gas development within the bounds of the Southern Ute Reservation would impact 1,368 acres in the short-term and 921 acres in the long-term. Oil and gas development within the Farmington EIS planning area would disturb approximately 36,451 acres in the short term and 18,600 acres in the long-term. Existing and proposed CBM development in the Project Area under Alternative 1 would disturb 2,504 acres in the short-term, and 2,160 acres in the long-term. Therefore, the total short-term disturbance from oil and gas development in the cumulative effects analysis area would be 40,323 acres.

The total long-term disturbance from oil and gas development in the cumulative effects analysis area would be 20,193 acres. Cumulative impacts to surface water quality would be greatest in the HD Mountains roadless area and in the northern portion of the Farmington EIS planning area.

One quantitative measure of CBM cumulative impacts are soil loss estimates. Soil loss was calculated using the RUSLE model (Renard et al. 1997) and accounts for surface erosion from CBM development only. Soil loss as a result of mass failures or other management activities are not included in the numbers presented. Table 3–30 summarizes CBM surface soil loss, a portion of which could be transported into Navajo Reservoir and the Animas River.

For the portion of the analysis area draining into Navajo reservoir, Alternative 2 would result in the greatest quantity of soil loss and potential sediment delivery into streams. Cumulative short-term soil loss would be approximately 23,723 tons/year. Alternative 1 would result in the next highest level of soil loss, 17,863 tons/year, followed by Alternative 1A at 16,375 tons/year. It is assumed that a high proportion of the projected soil loss would be delivered into streams, because the areas of greatest predicted soil loss are also the areas where terrain is steep, dissected, and a high level of construction occurs in the WIZ.

For the portion of the analysis area draining into the Animas River, sediment production differences between alternatives is not as pronounced. Alternative 2 would result in the greatest cumulative short-term soil loss, 2,471 tons/year. The other alternatives would have essentially the same cumulative soil loss numbers ranging from 1,829 tons/year to 1,805 tons/year.

Sedimentation from the Missionary Ridge Wildfire in 2002 also contributes cumulatively to water quality impacts. The watersheds that were burned in the Missionary Ridge fire are tributary to the Pine, Florida, and Animas Rivers. Lower-gradient channels have borne an increased sediment load since the fire, and short-term alterations in water chemistry have been observed (FS 2003a). The Missionary Ridge timber salvage project would contribute to cumulative sedimentation impacts along with gas development within the Project Area and the larger cumulative effects area. The EIS for the timber salvage project estimates that post-harvest sediment delivery to the Animas, Florida, and Pine Rivers would increase by a maximum of 6 percent (FS 2003a).

Alternatives 1 and 2 are expected to result in the largest overall watershed-wide increases in sediment production when soil loss, landslide activity, and other development projects are considered together. Alternatives 1 and 2 are expected to result in the largest risk of increased landslide activity because these two alternatives would involve the most extensive construction on steep, landslide-prone areas. Alternative 1A would result in the third highest overall sediment production followed by Alternative 4, 3, 1B, and 5 respectively. Disturbance in three watersheds that flow into Navajo Reservoir (Beaver Creek, Lower Los Pinos, and Lower Piedra) are expected to have the greatest overall impacts. Disturbance effects to streams may include increased water turbidity, increases in channel embeddedness, and deposits of sediment finer than existing bedload. Predicted large increases of sediment into streams have the highest risk of causing channel and floodplain adjustments in the tributaries to the main analysis area rivers where most of the ground disturbance would occur.

## Table 3–30 Cumulative Estimated Annual Soil Loss Totals for All action Alternatives

| | Total Soil Loss | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Alternative | | | | | | | | | | | | | |
| | | 1 | | 1A | | 1B | | 2 | | 3 | | 4 | | 5 | |
| Watershed | Existing Condition | Short-term | Long-Term | Short-term | Long-Term | Short-term | Long-Term | Short-term | Long-Term | Short-term | Long-Term | Short-term | Long-Term | Short-term | Long-Term |
| Animas River Watershed[1] | 1,594 | 1,829 | 1,762 | 1,829 | 1,762 | 1,829 | 1,762 | 2,471 | 2,193 | 1,829 | 1,762 | 1,808 | 1,741 | 1,805 | 1,746 |
| Navajo Reservoir Watershed[2] | 8,335 | 17,863 | 14,604 | 16,375 | 14,068 | 13,946 | 12,563 | 23,723 | 18,523 | 14,715 | 12,579 | 14,843 | 12,642 | 11,436 | 10,430 |

Notes:

1. Middle Animas Valley And Lower Florida River.
2. Beaver Creek, Middle Los Pinos River, Lower Los Pinos River, Lower Piedra River, and Stollsteimer Creek.

### 3.6.3.17 Irrigation and Fugitive Dust

Under Alternative 1, cumulative effects on the quality of irrigation water from fugitive dust are expected to be minimal because dust suppression measures would be used during development, and because generation of fugitive dust would be low during operation.

Cumulative effects to the quality of irrigation water from fugitive dust under Alternative 2 would be greater than the effects discussed for Alternative 1 because of the higher level of development in the Project Area. Alternatives 1A, 1B, 3, 4, and 5, in descending order of impact, would all result in less cumulative effects than Alternatives 1 and 2.

### 3.6.3.18 Surface Water Depletions and Dewatering the Fruitland Formation

Cumulatively, existing and future development of oil and gas resources would result in a loss of surface flow to streams within and downstream of the Project Area. This would occur as a result of CBM wells extracting, and re-injecting groundwater from the Fruitland Formation into deeper formations. Development within the Southern Ute Reservation would contribute minimally to depletions from Texas Creek. Farmington EIS planning area would not contribute to water depletions because this development is far away and down-dip of the areas where groundwater is discharged. Existing CBM development contributes to most of the existing and projected surface water depletions, while an increment of approximately 60 acre-feet could be depleted as a result of new development within proximity of the Piedra River.

The cumulative effects of existing and future development of oil and gas resources may also cause a loss of flow in springs and seeps along the Fruitland and Pictured Cliffs outcrops. Potential impacts would depend on the proximity of the cumulative proposed drill sites to these features.

Cumulative effects from surface water depletions and dewatering under Alternative 2 would be greater than the effects discussed for Alternative 1 because of the higher level of development in the Project Area. Alternatives 1A, 1B, 3, 4, and 5, in descending order of impact, would all result in less cumulative effects from surface water depletions than Alternatives 1 and 2.

### 3.6.3.19 Consumptive Use and Water Rights

Cumulative effects associated with Alternative 1 consider the consumptive use of water supplies for existing and proposed oil and gas development in the Project Area within the bounds of the Southern Ute Reservation and within the Farmington EIS Planning area. The projected consumption from the SUIT EIS is 535 acre-feet, or 27 acre-feet per year. The total fresh water use over the 20-year life of project under the selected alternative of the Farmington EIS is 7,000 acre-feet, or 350 acre-feet per year. Thus, the cumulative annual consumption of surface water supplies, including this project, would equal approximately 540 acre-feet per year. Surface waters in the cumulative effects analysis area should not be reduced in quantity since the water requirements for well drilling and completion would be acquired from already appropriated irrigation sources.

Cumulative effects to consumptive use and water rights under Alternative 2 would be greater than the effects discussed for Alternative 1 because of the higher level of development in the Project Area. Alternatives 1A, 1B, 3, 4, and 5, in descending order of impact, would all result in less consumptive use of surface water resources than Alternatives 1 and 2.

### 3.6.3.20 Beneficial Use of CBM Produced Waters

Cumulative effects from the beneficial use of CBM produced waters have not been realized, since surface discharge has not occurred, and would require additional analysis and permitting before it could occur. The suitability of the produced water for beneficial use would depend on the quality of the water to meet permit limitations for surface discharge and support the intended beneficial use. Additional surface water may be available for downstream livestock and agricultural operations to manage, provided discharge permits are authorized. Stock watering and irrigation likely would increase in and downstream of the Project Area, provided the quality of the water is suitable, or could be treated to levels that are suitable to meet these uses.

Cumulative effects from the beneficial use of CBM produced waters under Alternative 2 would be greater than the effects discussed for Alternative 1 because of greater volumes of produced water that would result from the higher level of development in the Project Area. Alternatives 1A, 1B, 3, 4, and 5, in descending order of impact, would all result in less beneficial use than Alternatives 1 and 2.

## 3.6.4 Mitigation and Monitoring

### 3.6.4.1 Mitigation

The following are recommended standard mitigation measures to reduce CBM development effects to surface water quality, quantity, and use. Unless otherwise stated, the measures will be funded by the companies.

- Avoid crossings of wetland and riparian areas during construction of infrastructure (pipelines, roads, and power lines) to the extent practicable. In the event that a wetland or riparian area must be crossed or disturbed, additional (site-specific) mitigation would be required. These measures could include:
    - All crossings of wetlands and other waters of the U.S. should comply with the appropriate USACE regulations (for example, Nationwide Permits 12 and 14). If potential effects exceed the limits of the Nationwide Permits, Individual Permits should be obtained.
    - Keep heavy equipment out of streams, swales, and lakes, except to cross at designated points, build crossings, or do restoration work, or if protected by at least 1 foot of packed snow or 2 inches of frozen soil. Keep heavy equipment out of streams during fish spawning, incubation, and emergence periods.
    - Keep ground vehicles out of wetlands unless protected by at least 1 foot of packed snow or 2 inches of frozen soil. Do not disrupt water supply or drainage patterns into wetlands.

- Construct crossings perpendicular to wetlands and riparian areas.
- Disturb wetland and riparian areas only during dry conditions (that is, during late summer or fall), or when the ground is frozen during the winter.
- Minimize the time and area of disturbance for road and pipeline at surface water crossings.
- Design and construct all stream crossings and other instream structures to provide for passage of flow and sediment, withstand expected flood flows, and allow free movement of resident aquatic life.
- Material should not be deposited anywhere within the WIZ, including riparian areas, floodplains, or natural drainage ways.
- Locate the lower edge of soil or other material stockpiles outside the active floodplain.
- Do not encroach fills or introduce soil into streams, swales, lakes, or wetlands.
- Reshape disturbed channels to their original configuration and properly stabilize.
- Begin reclamation of disturbed wetlands and riparian areas (or replacement if necessary) immediately after project activities are complete.
- Develop site-specific mitigation plans during the APD, plan of development, or Sundry Notice approval process for all proposed disturbance to wetlands and riparian areas.
- Limit construction of well pads, roads, and pipelines on slopes greater than 30 percent.

➢ Require the companies prior to construction activities to develop and implement SPCC and emergency response plans to prevent, contain, and remediate spills. Workers should also be well trained considering these plans.

➢ Avoid soil-disturbing actions during periods of heavy rains or wet soils.

➢ Conduct routine inspections of facilities, pipelines, and well sites to evaluate whether there are erosion problems, sedimentation, spills, or leaks and taking corrective actions, as appropriate.

➢ Plug and abandon non-productive wells and associated flowlines and equipment in a timely fashion to avoid leaks or breaks and subsequent spills.

➢ Route surface runoff from well pads into reserve pits, if appropriate.

➢ Implement BMPs to slow or reduce the flow of surface-water runoff across disturbed areas, including diversion of surface runoff around facilities and installing erosion control devices to prevent sedimentation of nearby water bodies. Relevant BMPs are included in Appendix F.

➢ Install road-grade culverts in areas of excessive runoff and follow construction BMPs or those defined by the FS or BLM.

➢ Prepare a Stormwater Management Plan for construction sites that disturb five or more acres during the life of the project, or are part of a larger common plan of development. An authorized Construction General Permit must also be issued by CDPHE.

- Implement structural erosion and sediment controls such as interim or permanent water bars, detention ponds, straw bales, silt fences, earth dikes, and inlet and outlet protection. Provide non-structural erosion control practices such as interim and permanent and temporary seeding and revegetation, and geotextiles.
- Reclaim and revegetate all or portions of roads, drill pads, and other oil and gas-related surface disturbance, as appropriate.
- Minimize erosion at sites located in steep terrain during the construction phase by measures such as contouring, water bars, temporary ditches, and detention basins, and minimize the period of disturbance.
- Use dust control as needed to minimize the production of fugitive dust during the construction phase. Dust control during the production phase should be assessed on a site-specific basis and used as needed.
- Prohibit construction during spring runoff (determined annually by the FS/BLM through inspection) and monsoon season (July to October) where construction of new facilities (roads, well pads, compressors etc.) occurs in floodplains or wetlands. Construction timing limitations would decrease the risk of facility site damage, water contamination, and stream and riparian impacts from flooding events.
- Avoid disturbance of unstable stream banks and headwall areas.
- Use existing roads and pipelines whenever practical and avoid constructing parallel roads and pipelines.
- Avoid fragile and unstable areas or implement appropriate mitigation measures.
- Locate roads outside the WIZ whenever possible to maintain water quality.
- Locate roads on stable topography, such as ridges, natural benches, and flatter transitional slopes near ridges and valley bottoms.
- Locate stream crossings where channels are well defined, unobstructed, stable and along straight reaches. Locating stream crossings on a meander bend will reduce stream length, exacerbate stream erosion, and potentially undermine the crossing.
- Size culverts to handle flows for the active channel width at a minimum.
- Size crossings to handle the theoretical 100-year flood.
- Locate culverts or drainage dips in such a manner to avoid outflows onto unstable terrain such as slumps, side-cast fills, and headwalls. Provide adequate drainage features along a road prism to avoid accumulation of water in ditches or surfaces.
- Provide energy dissipators (i.e. rock weirs) at culvert outlets or drain dips where water is discharged onto loose or erodible material.
- Preferred road gradients are 2 to 10 percent with a maximum grade of 15 percent. Consider steeper grades in those situations where they result in lesser environmental impact.
- Rock main roads that are likely to handle heavy traffic and likely to be used for extended periods of time.

- Provide for vegetative cover or artificial stabilization of cut and fill slopes in the road design process.
- Consider using drain dips (water bars) on roads which have gradients less than 10 percent and avoid dips on road gradients over 10 percent.
- Consider the guide below for proper drainage spacing for water bars.

**Table 3–31 Guide for Drainage Spacing by Soil Erosion Classes and Road Grade**

| | Water Bar Spacing by Erosion Class[1] (feet) | | |
|---|---|---|---|
| Gradient (%) | High | Moderate | Low |
| 3 – 5 | 200 | 300 | 400 |
| 6 – 10 | 150 | 200 | 300 |
| 11 – 15 | 100 | 150 | 200 |
| 16 – 20 | 75 | 100 | 150 |
| 21 – 35 | 50 | 75 | 100 |
| 36+ | 50 | 50 | 50 |

Note

1. Spacing is determined by slope distance and is the maximum allowed for the grade. This is a guide and conditions in the field may dictate different spacings than the table.

The extent of road reconstruction and maintenance that would occur during development of the proposed road system would provide opportunities to correct many of the problems and risks associated with the current road system. The following mitigation measures to address road-related problems and risks are recommended as site-specific project mitigation:

- Drainage crossings in the Bull Creek area (along National Forest System Road [NFSR] 841) should be armored with rock or replaced with culverts of appropriate size to reduce sediment production from wet crossings.
- Areas of mass wasting on NFSR 743 should be stabilized by rip-rapping; installing French drains; reshaping the fill slope to decrease water velocity and erosion; reseeding with aggressive, stabilizing plant species; applying geotechnical materials; using more advanced engineering; or other appropriate methods.
- The blocked egress from the culvert on NFSR 743 should be cleared of debris, so that it is functional.
- Gravel surfacing or other appropriate measures should be employed on NFSR 537 to reduce production of sediment.
- General maintenance should occur for all culverts along NFSR 537. Two culverts require specific attention. The ditches adjacent to these culverts should be cleaned out so that water will drain into the culverts properly. Gullied roadbed and fill slope areas should be repaired to prevent additional gullying.

- The slump along NFSR 537 should be monitored for movement, particularly if this road is widened. If movement occurs, measures similar to those recommended for NFSR 743 should be used to stabilize this area.
- The blocked culvert along NFSR 613 should be cleaned out to allow proper drainage. Any damage to the roadbed or ditches should be repaired to prevent future erosion.
- The blocked culvert along NFSR 132 should be cleaned out to allow proper drainage. Any damage to the roadbed or ditches should be repaired to prevent future erosion.
- The west end of NFSR 132 should be relocated to a position higher on the slope and out of the highly erosive soils of the flat. The surface should be covered with gravel to reduce future erosion. Gully plugs, riprapping, or similar methods should be used in the existing gullies in the flat to prevent any further erosion and to increase sediment retention.
- All new roads determined to be excess to Forest and BLM road transportation needs would be recontoured and revegetated to agency standards after the project is complete. Road stream crossings would be restored to original channel dimensions and grade. By closing as many new roads as possible, the density of open roads would be reduced as much as possible toward meeting LRMP standards and guidelines.
- Locate culverts along straight stream reaches that are relatively stable (stream reaches that are not aggrading or degrading) to minimize in stream erosion.
- Locate new access roads in areas on less than 40 percent side slopes to minimize erosion.

### 3.6.4.2 Monitoring

- Require the companies to fund and implement a surface water quality monitoring program for the Project Area to evaluate the presence or absence of impacts associated with contamination of surface water from CBM. Monitoring of stormwater controls should be conducted at least once each year, preferably after precipitation events that have the potential to cause surface erosion.
- Require the companies to fund a third party contractor approved by the agencies to monitor the trend and magnitude of dewatering effects at the Fruitland outcrop. This applies to the major rivers affected through gain-loss studies on the Pine, Piedra, and Florida Rivers.
- Require the companies to identify, inventory, and monitor areas where natural springs and seeps are present along the Pictured Cliff and Fruitland Formation outcrop. Monitor approximately 10 spring/wetland areas every other year to assess groundwater depletion impacts.
- Review adequacy of BMPs and inspect the condition of water influence zones after all construction-related activities are completed. This type of monitoring should occur over the entire drilling and completion phase since it will occur over several years. Monitor BMP and mitigation implementation and effectiveness each year for a representative sample of activities occurring on federal lands during project buildout. Focus pri-

marily on mitigation measures pertaining to stormwater runoff prevention, road construction, and other ground disturbing activities.

## 3.6.5 Conformance with Existing Plans and Policies

### 3.6.5.1 FS Land Use Plans and Policies

The amended LRMP for the San Juan National Forest (FS 1992) contains the following direction for managing surface water resources on National Forest lands.

#### *3.6.5.1.1 Forest Direction (Water Quality)*

Direction: Improve or maintain water quality to meet State water quality standards. However, where the natural background water pollutants cause degradation, it is not necessary to implement improvement actions. Short-term or temporary failure to meet some parameters of the State standard, such as increased sediment from road crossing construction or water resource development may be permitted in special cases (LRMP, III-47).

Standard: Colorado State Water Quality Standards (CDPHE 2002a).

Direction: Rehabilitate disturbed areas that are contributing sediment directly to perennial streams as a result of management activities to maintain water quality and reestablish vegetation cover (LRMP, III-48).

Guideline: Reduce to natural rate any erosion due to management activity in the season of disturbance and sediment yields within one year of the activity through necessary mitigation measure such as water-barring and revegetation (LRMP, III-48).

#### *3.6.5.1.2 Management Area Direction (Riparian Areas)*

Direction: Manage riparian areas to reach the latest seral stage possible within the stated objectives (LRMP, III-254).

Guideline:

a) Maintain all riparian ecosystems in at least an upper mid-seral successional stage based upon the R2 Riparian Ecosystem Rating System.

Direction: Minimize detrimental disturbance to the riparian area by mineral activities. Initiate timely and effective rehabilitation of disturbed areas and restore riparian areas to a state of productivity comparable to that before disturbance (LRMP Amendment, III-261).

Guidelines:

a) Prohibit the depositing of soil material from drilling, processing or site preparation in natural drainageways.

b) Locate the lower edge of disturbed or deposited soil banks outside the active floodplain.

c) Prohibit stockpiling of topsoil or any other disturbed soil in the active floodplain.

d) Discontinue heavy equipment use when soil compaction, rutting, and puddling are present.

Direction: Locate roads and trails outside riparian areas unless alternative routes have been reviewed and rejected as being more environmentally damaging (LRMP Amendment, III-263).

Guidelines:

a) Do not parallel streams when road locations must occur in riparian areas except where absolutely necessary. Cross streams at right angles. Locate crossings at points of low bank slope and firm surfaces.

b) Maintain the natural width-to-depth ratio of the stream at channel crossing.

### *3.6.5.1.3 Other Applicable Riparian Management Area Direction from LRMP*

- Proposed new land-use facilities will not normally be located in floodplain boundaries for the 100 year flood. Protect present and all necessary future facilities that cannot be located out of the 100-year floodplain by structural mitigation (deflection structures, riprap, etc.)
- Prevent stream channel instability, loss of channel cross-sectional areas, and loss of water quality resulting from activities that alter vegetative cover.
- Maintain sediment yield within threshold limits. The effects on water and sediment yields from vegetation manipulation and road construction projects will be determined through the use of appropriate modeling and/or quantification procedures to determine sediment yield threshold limits and water yield increase potentials.
- Avoid channelization of natural streams.
- Treat disturbed areas resulting from management activities to reduce sediment yields to the natural erosion rates in the shortest possible time.

Riparian areas would be avoided where possible. If avoidance is not possible, mitigation measures would be implemented to reduce impacts. Conformance with the direction listed above regarding Riparian Area Management will be determined as field inspections are conducted to finalize facility locations on the ground. Field inspections to date indicate plan conformance for facility location.

The current watershed analysis indicates that the project as proposed would not conform to the Forest General Direction Standard for Water Resource Improvement and Maintenance (LRMP, III-47). Water quality is not predicted to be improved or maintained in all streams in the planning area. High levels of stream sedimentation are predicted in some streams in all alternatives as a result of new construction. Because facilities may be constructed in water influence zones, there is an elevated risk that chemical leaks may reach surface drainages. Due to the projected non-conformance with this standard, the appropriate state, local, and federal agencies will be consulted to cooperatively develop strategies to achieve conformance.

### 3.6.5.2 Conformance with BLM Land Use Plans and Policies

The RMP for the San Juan/San Miguel Resource Areas (BLM 1985) established general management objectives and guidelines for water resources to maintain surface water quality and preserve existing water uses. Water resources are evaluated on a case-by-case basis at the project level planning stage. Stipulations for surface water resource management are attached to each project plan as appropriate, and BMPs listed in the RMP appendix are recommended.

Additionally, in 1991 the BLM Director approved the *Riparian-Wetland Initiative for the 1990's*, which establishes national goals and objectives for managing riparian-wetland resources on public lands. One of the chief goals of this initiative is to restore and maintain riparian-wetland areas so that 75 percent or more are in proper functioning condition (PFC) by 1997. The overall objective of this goal is to achieve advanced ecological status, except where resource management objectives, including PFC, would require an earlier successional stage, thus providing the widest variety of vegetation and habitat diversity for wildlife, fish, and watershed projection (Prichard et al. 1993).

Authorization of the Proposed Action would require full compliance with RMP management directives that relate to maintaining or improving surface water quality and quantity. With the implementation of the mitigation measures following each described Stipulation Code, all action alternatives are in conformance with the RMP for the San Juan/San Miguel Resource Areas (BLM 1985) and the ROD for Oil and Gas Plan Amendment to the San Juan/San Miguel RMP (BLM 1991):

Stipulation Code CO–28 states, "For the protection of perennial water impoundment and streams, and/or riparian /wetland vegetation zones, activities associated with oil and gas exploration and development including roads, transmission lines, storage facilities, are restricted to an area beyond the riparian vegetation zone." This stipulation may be excepted subject to an on-site impact analysis with consideration given to degree of slope, soils, importance to the amount and type of wildlife and fish use, water quality, and other related values.

Stipulation Code CO–27 specifies prior to surface disturbance on slopes of, or greater than, 40 percent, an engineering/reclamation plan must be approved by the Authorized Officer. Such plans must demonstrate how the following will be accomplished:

a. Site productivity will be restored.

b. Surface runoff will be adequately controlled.

c. Off-site areas will be protected from accelerated erosion such as drilling, gullying, piping, and mass wasting.

d. Surface-disturbing activities will not be conducted during extended wet periods.

e. Construction will not be allowed when soils are frozen.

All action alternatives are in compliance with the RMP and the ROD. Additionally, on BLM Lands all action alternatives will meet the objectives and goals of the BLM *Riparian-Wetland Initiative for the 1990's*.

### 3.6.5.3 Executive Order 11990 — Protection of Wetlands and Executive Order 11988 — Floodplain Management

The Protection of Wetlands order requires Federal agencies to take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. Analysis is required to determine whether adverse impacts to wetlands would result.

The Protection of Floodplains order requires Federal agencies to provide leadership and to take action to (1) minimize adverse impacts associated with occupancy and modification of floodplains and reduce risks of flood loss, (2) minimize the impacts of floods on human safety, health, and welfare, and (3) restore and preserve the natural and beneficial values served by floodplains.

Alternatives 1 through 5 include facility locations planned in floodplains and wetlands on forest lands covered by E.O. 11988 and E.O. 11990. Consistent with Forest Plan direction and executive orders, floodplain impacts will be avoided by moving proposed activities out of floodplain areas where possible when NOSs, APDs and ROW applications are received. To date, 56 well locations and associated roads and pipeline routes have been field sited. Of these, 47 have been located outside of floodplains and 9 have potential floodplain impacts. This latter category requires additional field work to determine actual floodplain boundaries and potential impacts.

For all APDs received in the Project Area, conformance with E.O. 11988 (Floodplain Management) and E.O. 11990 (Protection of Wetlands) will be determined by following the eight step process outlined in Forest Service Manual Amendment No. 2500-2000-2 for Watershed and Air Management. In accordance with this process, the public will be provided with a finding and explanation of any final decision if there is no practicable alternative to locating project activities in a floodplain.

The eight step process is:

1. Determine whether the proposed action is located in the base floodplain (500-year floodplain for critical actions); or whether it has the potential to affect a floodplain or indirectly support floodplain development. If not, or if an action is of an emergency nature (FSM 2527.06b), requirements of the Executive order will have been satisfied.
2. Notify the public at the earliest possible time of any plan or proposal to undertake, support, or allow an action which would result in the occupancy, modification, or development in a floodplain, and involve the affected and interested public in the decisionmaking process.
3. Identify and evaluate practicable alternatives to locating a proposed action in a floodplain, including alternative sites outside the floodplain, alternative actions serving the same purpose as the proposed action, and the "no action" option.
4. Identify the full range of potential direct or indirect adverse impacts associated with the occupancy or modification of the floodplain and the potential direct and indirect support of floodplain development that could result from the proposed action.
5. Identify and evaluate mitigating measures that will minimize the potential adverse impacts of the action if avoidance cannot be achieved, and measures that will preserve and restore or enhance the natural and beneficial floodplain values that would be adversely impacted by the action.
6. Reevaluate the proposed action to determine first, if it is still practical, even with the application of appropriate mitigating measures and in light of its exposure to flood hazards and its potential to adversely affect the floodplain and, second, if the alternatives identified in step 3 are practicable in light of information gained in the preceding steps 4 and 5.
7. Prepare and provide the public with a finding and public explanation of any final decision that there is no practicable alternative to locating an action in, or adversely affecting, a floodplain.
8. Provide ongoing review of implementation and post-implementation phases of the proposed action to ensure that all provisions associated with the action, including appropriate mitigating measures as identified in the environmental assessment, are fully implemented.

### 3.6.6 Unavoidable Adverse Effects

Unavoidable adverse effects on surface water resources would occur under each of the five alternatives. Erosion and sedimentation of surface water drainages would occur during construction when well pads and access roads are cleared of vegetation, and before reclamation, when vegetation has not been reestablished. CBM development will also intercept about 200 acre-feet of groundwater that would normally discharge into the Animas, Florida, Pine, and Piedra Rivers.

There may be additional impacts to existing water rights on some streams when calls cannot be satisfied by existing instream flows.

## 3.6.7 Irreversible and Irretrievable Effects

An irreversible or irretrievable commitment of resources would occur when resources would be consumed, committed, or lost as a result of the project. The commitment of resources would be irreversible if the project started a process (chemical, biological, or physical) that could not be stopped. As a result, the resource or its productivity or its utility would be consumed, committed, or lost forever. Commitment of a resource would be considered irretrievable when the project would directly eliminate the resource, its productivity, or its utility for the life of the project and possibly beyond.

The commitment of surface waters would be irretrievable when the project directly eliminates the water source, such as when surface water supplies are used for well drilling and completion. The project would consume approximately 55 to 261 acre-feet of irrigation waters or municipal supplies in total, depending on the alternative.

# 3.7 Soils

## 3.7.1 Issues

*Issue 15: The effects of the additional CBM development on soils in and downstream of the project area.*

- To what degree does road and well pad construction contribute to soil erosion?
- What is the potential for contaminant spills and how would they affect soils? (Addressed in Health and Safety)
- Will CBM development contribute to loss of topsoil and how would that, in turn, affect agriculture, forestry, and wildlife habitat?

## 3.7.2 Affected Environment

### 3.7.2.1 Regional Characterization

Soils within the Project Area have developed in residuum, colluvium, alluvium, and, to a lesser extent, in eolian materials derived from interbedded sandstones and shales in the lower areas. They also have developed from igneous and metamorphic materials in the higher, more mountainous areas (Bauer et al. 1981). Surface textures range from clay loams to sandy loams with varying amounts of gravel or coarser materials. Slopes range from nearly level to very steep, with deeper soils found in the less steeply sloping areas.

Two soil surveys have been completed throughout the Project Area: the La Plata County survey in the west, and the Piedra Area survey in the east. Soils series from the two surveys with matching names or similar characteristics were merged into one map unit for continuity. Figure 3–30 shows the distribution of the 55 soil map units that resulted from this merge. Each map unit is named for the dominant soil types. Summaries of the areal extent of all map units in the Project Area, the dominant soils series for all associations in the Project Area, and the general characteristics of the soils are shown on Table 3–32 and Table 3–33.

The areal extent of each map unit in the Project Area is listed on Table 3–32, along with the dominant soil series for all the associations in the Project Area and the general characteristics of the soil. Table 3–34 lists the severity of hazards based on these characteristics. Series with severe wind and water erosion hazards, high potential for compaction, high salinity, poor potential for revegetation, and prime or otherwise valuable agricultural soils are identified in the table.

### Table 3–32 Areal Extent of Soils in the Project Areas

| Map Unit | Soil Series | Surface Texture | Area (Acres) | Percent Coverage |
|---|---|---|---|---|
| *La Plata Soil Survey* | | | | |
| 2 | Alamosa | Loam | 428 | 0.34 |
| 5 | Arboles | Clay | 6,285 | 5.01 |
| 7 | Archuleta<br>Sanchez | Loam<br>Very Stony Sandy Clay Loam | 14,860 | 11.86 |
| 9[1] | Badland | Shale | 1,124 | 0.90 |
| 10 | Bayfield | Silty Clay Loam | 178 | 0.14 |
| 12 | Bayfield | Silty Clay Loam, Seeped | 350 | 0.28 |
| 13 | Big Blue | Clay Loam | 431 | 0.34 |
| 14 | Bodot | Clay | 1,666 | 1.33 |
| 22 | Corta | Loam | 863 | 0.69 |
| 23[2] | Corta | Loam | 7,332 | 5.85 |
| 25 | Durango | Cobbly Loam | 236 | 0.19 |
| 26 | Falfa | Clay Loam | 875 | 0.70 |
| 27 | Falfa | Clay Loam | 4,644 | 3.71 |
| 28 | Fluvaquents | Gravelly Cobbly Sandy Loam | 910 | 0.73 |
| 29 | Fortwingate | Stony Fine Sandy Loam | 68 | 0.05 |
| 30 | Fortwingate<br>Rock Outcrop | Stony Fine Sandy Loam<br>Rock | 1,321 | 1.05 |
| 32 | Haploborolls<br>Rubble Land | Stony Sandy Loam<br>Rock Fragments | 94 | 0.07 |
| 34 | Harlan | Cobbly Loam | 9 | 0.01 |
| 37 | Herm | Loam | 3,434 | 2.74 |
| 39 | Hesperus | Loam | 3,139 | 2.50 |
| 42 | Lazear<br>Rock Outcrop | Stony Loam<br>Rock | 625 | 0.50 |
| 44 | Mikim | Loam | 124 | 0.10 |
| 45 | Nebar | Stony Sandy Loam | 7 | 0.01 |
| 50[3] | Pescar | Fine Sandy Loam | 919 | 0.73 |
| 53 | Pinata | Loam | 111 | 0.09 |
| 58 | Rock Outcrop | Rock | 790 | 0.63 |
| 59 | Sedillo | Gravelly Sandy Loam | 426 | 0.34 |
| 60 | Shalona | Loam | 21 | 0.02 |
| 62 | Sili | Loam | 117 | 0.09 |
| 63 | Sili | Loam | 69 | 0.06 |
| 64 | Simpactico | Loam | 388 | 0.31 |
| 65 | Sycle | Fine Sandy Loam | 104 | 0.08 |
| 66 | Tefton | Loam | 433 | 0.35 |
| 70[4] | Ustic Torriorthents<br>Ustollic Haplargids | Gravelly Sandy Loam<br>Gravelly sandy loam | 2,622 | 2.09 |
| 74 | Vosburg | Fine Sandy Loam | 374 | 0.30 |
| 76 | Witt | Loam | 9 | 0.01 |
| 81 | Zyme | Clay Loam | 3,257 | 2.60 |
| 82 | Rock Outcrop | Rock | 9,169 | 7.32 |
| *Piedra Soil Survey* | | | | |
| 4D | Carracas | Loam | 3,830 | 3.06 |
| 4E | Carracas | Loam | 21,405 | 17.08 |
| 8E | Chris | Gravelly Loam | 1,531 | 1.22 |
| 11E | Corta | Silt Loam | 13,889 | 11.08 |
| 12D | Dunton | Loam | 1,113 | 0.89 |
| 13D | Dunton | Stony Loam | 97 | 0.08 |

## Table 3–32 Areal Extent of Soils in the Project Areas

| Map Unit | Soil Series | Surface Texture | Area (Acres) | Percent Coverage |
|---|---|---|---|---|
| 16D | Greenough | Loam | 233 | 0.19 |
| 19D | Helfin | Sandy Loam | 1,708 | 1.36 |
| 22A | Hunchback | Clay Loam | 141 | 0.11 |
| 22D | Hunchback | Clay Loam | 789 | 0.63 |
| 30E | Mayoworth | Silt Loam | 1,361 | 1.09 |
| 36A | Nunn | Loam | 6,432 | 5.13 |
| 36D | Nunn | Loam | 4,762 | 3.80 |
| 39A | Riverwash | Rock, Gravel, Stone | 110 | 0.09 |
| 84 | Open Water | | 127 | 0.10 |

Notes:

1. The 3 Badland, from the Piedra Survey, was merged with 9 Badland from the La Plata Survey.
2. The 11D Corta Silt Loam, from the Piedra Survey, was merged with 23 Corta Loam from the La Plata Survey.
3. The 38A Pescar Sandy Loam, from the Piedra Survey, was merged with 50 Pescar Fine Sandy Loam from the La Plata Survey.
4. The 43 Sandstone Outcrop-Ustorthents Complex, from the Piedra Survey, was merged with 70 Ustic Torriorthents-Ustollic Haplargids Complex from the La Plata Survey.

## Table 3–33 Characteristics of Soil Map Units

| Map Unit | Soil Series | Surface Texture | Physiographic Location | Parent Material | Slopes (%) | Depth Class | Drainage class | Available Water Capacity | Clay Content | Permeability | Salinity | K-Factor | T-Factor | Wind Erodibility | Land Capability | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *La Plata County Soil Survey* | | | | | | | | | | | | | | | Non-Irr | Irr |
| 2 | Alamosa | Loam | Alluvial valley floors, fans, and bottoms | Alluvium | 0-2 | Deep | Poor | High | 15-35 | 0.2-0.6 | <2 | 0.26 | 5 | 6 | Vw | IIIw |
| 5 | Arboles | Clay | Side slopes, upland valleys | Alluvium from shale (sh) | 3-12 | Deep | Well | High | 35-55 | 0.06-0.2 | <2 | 0.37 | 5 | 4 | IV e | IV e |
| 7 | Archuleta | Loam | Hills, ridges, mountainsides | Residuum from interbedded sandstone (ss) and sh | 12-65 | Shallow | Well | Low | 18-35 | 0.6-0.2 | <2 | 0.24 | 1 | 6 | VII e | --- |
| | Sanchez | Very Stony Sandy Clay Loam | | | | Shallow | Well | Very Low | 20-35 | 0.2-0.6 | <2 | 0.10 | 1 | 6 | | |
| 9[1] | Badland | Shale | Steep and very steep | Mancos sh | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | VIII e | --- |
| 10 | Bayfield | Silty Clay Loam | Broad valleys | Alluvium from sh | 1-3 | Deep | Well | High | 30-50 | 0.06-0.2 | <4 | 0.24 | 5 | 5 | VI e | III e |
| 12 | Bayfield | Silty Clay Loam, Seeped | Broad valleys | Alluvium from sh | 1-3 | Deep | Poor | High | 30-50 | 0.06-0.2 | <4 | 0.24 | 5 | 5 | VI w | IV w |
| 13 | Big Blue | Clay Loam | Low terraces, valley bottoms, alluvial valley floors | Alluvium from sh | 0-6 | Deep | Poor | High | 27-50 | 0.06-0.2 | <2 | 0.24 | 5 | 5 | V w | V w |
| 14 | Bodot | Clay | Hills | Residuum from sh | 3-10 | Moderately Deep | Well | Low | 35-50 | 0.06-0.2 | 2-8 | 0.32 | 2 | 4 | IV e | IV e |
| 22 | Corta | Loam | Mesa tops, ridgetops, old pediment surfaces | Alluvium from sh mixed with loess | 1-3 | Deep | Well | High | 20-50 | <0.06 | <2 | 0.37 | 4 | 5 | III c | III e |
| 23[2] | Corta | Loam | Mesa tops, ridgetops, old pediment surfaces | Alluvium from sh mixed with loess | 3-8 | Deep | Well | High | 20-50 | <0.06 | <2 | 0.37 | 4 | 5 | IV e | IV e |
| 25 | Durango | Cobbly Loam | Mesa tops, ridgetops dissected by drainages | Glacial outwash | 3-20 | Deep | Well | High | 10-50 | .2-2.0 | <2 | 0.32 | 5 | 8 | VII s | --- |
| 26 | Falfa | Clay Loam | Mesa tops | Calcerous loess | 1-3 | Deep | Well | High | 28-50 | .06-.6 | <2 | 0.28-0.32 | 5 | 4 | III c | III e |
| 27 | Falfa | Clay Loam | Mesa tops | Calcerous loess | 3-8 | Deep | Well | High | 28-50 | .06-.6 | <2 | 0.28-0.32 | 5 | 4 | IV e | IV e |
| 28 | Fluvaquents | Gravelly Cobbly Sandy Loam | Recent alluvial valley floors | Alluvial deposits | 0 | Deep | Somewhat poorly | Very Low | 0-10 | 2.0-6.0 | <2 | 0.10 | 5 | 2 | VII w | --- |
| 29 | Fortwingate | Stony Fine Sandy Loam | Mountainsides | Ss mixed with loess | 3-12 | Deep | Well | Low | 8-45 | 0.2-6.0 | <2 | 0.15-0.28 | 2 | 4 | VI e | --- |
| 30 | Fortwingate | Stony Fine Sandy Loam | Mountainsides | Ss mixed with loess | 6-25 | Deep | Well | Moderate | 8-45 | 0.2-6.0 | <2 | 0.15-0.28 | 2 | 4 | VII s | --- |

## Table 3–33 Characteristics of Soil Map Units

| Map Unit | Soil Series | Surface Texture | Physiographic Location | Parent Material | Slopes (%) | Depth Class | Drainage class | Available Water Capacity | Clay Content | Permeability | Salinity | K-Factor | T-Factor | Wind Erodibility | Land Capability | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rock Outcrop | Rock | | Sandstone | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | VIII e | --- |
| 32 | Haploborolls | Stony Sandy Loam | Mountainsides | --- | 10-60 | Moderately Deep | Well | Moderate | 18-35 | 0.2-2.0 | <2 | 0.10 | 5 | 8 | VII e | --- |
| | Rubble Land | Rock Fragments | | Surrounding rock | | --- | --- | --- | --- | --- | --- | --- | --- | --- | VIII e | --- |
| 34 | Harlan | Cobbly Loam | Terraces along drainages on mesas | Cobbly alluvium, glacial outwash | 3-15 | Deep | Well | Moderate | 10-35 | 0.6-6.0 | <2 | 0.10-0.24 | 5 | 8 | VI e | --- |
| 37 | Herm | Loam | Mountainside, valley floors | Alluvium from sh | 6-25 | Deep | Well | High | 15-50 | 0.06-2.0 | <2 | 0.24 | 5 | 5 | VI e | --- |
| 39 | Hesperus | Loam | Alluvial fans, valley bottoms | Alluvium | 3-12 | Deep | Well | High | 10-35 | 0.6-20.0 | <2 | 0.28-0.32 | 5 | 5 | IV e | IV e |
| 42 | Lazear | Stony Loam | Edge of mesas and breaks | Residual material from ss and sh | 12-65 | Shallow | Well | Very Low | 15-32 | 0.6-2.0 | <2 | 0.17-0.20 | 1 | 8 | VII s | --- |
| | Rock Outcrop | Rock | | Sandstone | | --- | --- | --- | --- | --- | --- | --- | --- | --- | VIII e | --- |
| 44 | Mikim | Loam | Alluvial fans, foothill valleys | Alluvium | 3-12 | Deep | Well | High | 10-32 | 0.6-2.0 | <2 | 0.32 | 5 | 5 | IV e | IV e |
| 45 | Nebar | Stony Sandy Loam | Terraces along major drainageways | Glacial outwash or till | 1-6 | Deep | Well | Low | 10-50 | 0.2-6.0 | <2 | 0.05-0.15 | 2 | 8 | VI e | --- |
| $50^3$ | Pescar | Fine Sandy Loam | Flood plains, low terraces, alluvial valley floors | Stratified calcareous alluvium | 0-2 | Deep | Somewhat poorly | Low | 8-18 | 2.0-20.0 | <2 | 0.05-0.24 | 5 | 3 | IV w | IV w |
| 53 | Pinata | Loam | Mountainsides | Glacial outwash, till mixed with eolian sediment | 12-40 | Deep | Well | Moderate | 10-60 | 0.06-2.0 | <2 | 0.15-0.32 | 3 | 5 | VII e | --- |
| 58 | Rock Outcrop | Rock | Cliffs, breaks, ridges, mountainsides | Sandstone, limestone, quartzite, granite, shist | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | VIII e | --- |
| 59 | Sedillo | Gravelly Sandy Loam | Old, high terraces of major river valleys | Cobbly glacial outwash | 0-3 | Deep | Well | Moderate | 18-35 | 0.2-2.0 | <2 | 0.10-0.20 | 3 | 9 | Vi s | --- |
| 60 | Shalona | Loam | Old, high terraces | Mixed alluvium from ss and sh | 1-6 | Deep | Well | High | 10-35 | 0.2-6.0 | <2 | 0.24 | 5 | 4 | III e | III e |
| 62 | Sili | Loam | Upland valley bottoms, fans | Alluvium from sh | 1-3 | Deep | Well | High | 27-50 | 0.2-0.6 | <2 | 0.37 | 5 | 4L | IV c | III e |
| 63 | Sili | Loam | Upland valley bottoms, fans | Alluvium from sh | 3-6 | Deep | Well | High | 27-50 | 0.2-0.6 | <2 | 0.37 | 5 | 4L | IV e | III e |
| 64 | Simpactico | Loam | In drainageways on mesa tops | Alluvium from loess | 1-3 | Deep | Well | High | 10-35 | 0.2-2.0 | <2 | 0.28-0.32 | 4 | 5 | III c | III e |

## Table 3–33 Characteristics of Soil Map Units

| Map Unit | Soil Series | Surface Texture | Physiographic Location | Parent Material | Slopes (%) | Depth Class | Drainage class | Available Water Capacity | Clay Content | Permeability | Salinity | K-Factor | T-Factor | Wind Erodibility | Land Capability | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65 | Sycle | Fine Sandy Loam | Terraces on major drainageways | Alluvium overlying river-deposited cobbles and gravel | 1-3 | Deep | Well | Low | 0-35 | 0.6-20.0 | <2 | 0.02-0.28 | 3 | 6 | III c | III e |
| 66 | Tefton | Loam | Flood plains, alluvial valley floors | Mixed alluvium | 1-3 | Deep | Poor | High | 0-35 | 0.2-20.0 | <2 | 0.02-0.37 | 5 | 8 | III w | III w |
| 70[4] | Ustic Torriorthents | Gravelly Sandy Loam | Terrace and mesa edges, hillsides | Outwash | 12-60 | Deep | Well | Low | 5-25 | 0.6-2.0 | <2 | 0.05 | 5 | 8 | VII e | --- |
| | Ustollic Haplargids | gravelly sandy loam | | Gravelly, cobbly alluvium | | Deep | Well | Low | 5-30 | 0.6-6.0 | <2 | 0.17-0.20 | 5 | 6 | --- | --- |
| 74 | Vosburg | Fine Sandy Loam | Swales, foot slopes of uplands | Alluvium from ss and sh | 3-8 | Deep | Well | High | 8-35 | 0.6-6.0 | <2 | 0.20-0.24 | 3 | 3 | IV e | IV e |
| 76 | Witt | Loam | Uplands and mesas | Calcareous loess | 3-8 | Deep | Well | High | 10-30 | 0.2-2.0 | <2 | 0.37-0.43 | 5 | 5 | IV e | IV e |
| 81 | Zyme | Clay Loam | Ridges, hills | Residuum from loess | 3-25 | Deep | Well | Low | 35-45 | 0.06-0.6 | <2 | 0.43 | 1 | 4 | VI e | --- |
| 82 | Zyme | Clay Loam | Ridges, hills | Residual from sh | 12-65 | Shallow | Well | Low | 35-45 | 0.06-0.6 | <2 | 0.43 | 1 | 4 | VII e | --- |
| | Rock Outcrop | Rock | | Shale | | --- | --- | --- | --- | --- | --- | --- | --- | --- | VIII e | --- |
| *Piedra Area Soil Survey* | | | | | | | | | | | | | | | | |
| 4D | Carracas | Loam | Ridge tops, mesas | Residuum of interbedded ss and sh | 4-25 | Shallow | Low | Low | NA | 0.6-2.0 | --- | 0.20 | 1 | 5 | VI e | |
| 4E | Carracas | Loam | Valley, canyon sides, scarp slopes | Residuum and alluvium of ss | 25-65 | Shallow | Low | Low | NA | 0.6-2.0 | --- | 0.20 | 1 | 5 | VII e | |
| 8E | Chris | Gravelly Loam | Mesas | Residuum of interbedded ss and sh | 25-65 | Deep | Moderate | Low | NA | 0.06-2.0 | <2 | 0.1-0.24 | 3 | 5 | VI e | |
| 11E | Corta | Silt Loam | Canyon/Sides | Residuum and alluvium of ss | 25-65 | Deep | Well | Moderate | NA | <0.06-0.6 | <2 | 0.28-0.37 | 3 | 5 | VII e | |
| 12D | Dunton | Loam | Mesa and cuesta dip-slopes | Residuum of ss | 4-25 | Moderately Deep | Well | Moderate | NA | 0.06-2.0 | --- | 0.24-0.32 | 2 | 5 | VI e | |
| 13D | Dunton | Stony Loam | Mesa and cuesta dip-slopes | Residuum of ss | 4-25 | Moderately Deep | Well | Moderate | NA | 0.06-2.0 | --- | 0.24-0.32 | 2 | 5 | VI s | |
| 16D | Greenough | Loam | Low, rolling hills | Loess over ss and sh | 4-25 | Deep | Well | High | NA | 0.6-2.0 | --- | 0.37 | 3 | 5 | VI e | |
| 19D | Helfin | Sandy Loam | Valley toe slopes | Alluvium of mostly ss and some sh | 4-25 | Deep | Well | High | NA | 0.2-2.0 | --- | 0.32 | 3 | 3 | VI e | |

## Table 3–33 Characteristics of Soil Map Units

| Map Unit | Soil Series | Surface Texture | Physiographic Location | Parent Material | Slopes (%) | Depth Class | Drainage class | Available Water Capacity | Clay Content | Permeability | Salinity | K-Factor | T-Factor | Wind Erodibility | Land Capability |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22A | Hunchback | Clay Loam | Swales, basins, concave drainageways | Alluvium and colluvium of mixed origin | 0-4 | Deep | Somewhat poorly | High | NA | 0.06-0.2 | <2 | 0.32 | 5 | 6 | VI w |
| 22D | Hunchback | Clay Loam | Fans and toe-slopes | Alluvium and colluvium of mixed origin | 4-15 | Deep | Somewhat poorly | High | NA | 0.06-0.2 | <2 | 0.32 | 5 | 6 | VI e |
| 30E | Mayoworth | Silt Loam | Mesas, scarp slopes, valley sides | Residuum of sh and sandy sh | 25-65 | Moderately Deep | Well | Moderate | NA | 0.06-2.0 | <2 | 0.37-0.43 | 2 | 5 | VII e |
| 36A | Nunn | Loam | Alluvial plains and piedmonts | Alluvium of sh and some ss | 0-4 | Deep | Well | Moderate | NA | 0.06-2.0 | <2 | 0.24-0.28 | 5 | 5 | III e |
| 36D | Nunn | Loam | Alluvial plains and piedmonts | Alluvium of sh and some ss, | 4-25 | Deep | Well | Moderate | NA | 0.06-2.0 | <2 | 0.24-0.28 | 5 | 5 | IV e |
| 39A | Riverwash | Rock Gravel Stone | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | VIII w |

Notes:
1 The 3 Badland, from the Piedra Survey, was merged with 9 Badland from the La Plata Survey.
2 The 11D Corta Silt Loam, from the Piedra Survey, was merged with 23 Corta Loam from the La Plata Survey.
3 The 38A Pescar Sandy Loam, from the Piedra Survey, was merged with 50 Pescar Fine Sandy Loam from the La Plata Survey.
4 The 43 Sandstone Outcrop-Ustorthents Complex, from the Piedra Survey, was merged with 70 Ustic Torriorthents-Ustollic Haplargids Complex from the La Plata Survey.
Rock Outcrop, Rubble Land, and Riverwash consist almost entirely of hard rock and will not be characterized as soils for this analysis

## Table 3–34 Severity of Hazards for Soils in Project Area

| Map Unit | Soil Series | Salinity | Shrink/Swell | Water Erosion Hazard | Wind Erosion Hazard | Prime Agriculture Soils | Revegetation Potential |
|---|---|---|---|---|---|---|---|
| *La Plata County Soil Survey* | | | | | | | |
| 2 | Alamosa | Low | Moderate | Low | Low | No | Moderate |
| 5 | Arboles | Low | High | Moderate | Moderate | No | Moderate |
| 7 | Archuleta<br>Sanchez | Low | Moderate | Moderate | Low | No | Low |
| 9[1] | Badland | Low | Low | High | High | No | Low |
| 10 | Bayfield | Low | High | High | Low | Yes | Moderate |
| 12 | Bayfield | Low | High | Low | Low | No | Moderate |
| 13 | Big Blue | Low | High | Low | Low | No | Moderate |
| 14 | Bodot | Low-Moderate | High | High | Moderate | No | Moderate |
| 22 | Corta | Low | High | Moderate | Low | Yes | High |
| 23[2] | Corta | Low | High | Moderate | Low | Yes | Moderate |
| 25 | Durango | Low | Moderate-High | Low | None | No | Low |
| 26 | Falfa | Low | Moderate-High | Moderate | Moderate | Yes | High |
| 27 | Falfa | Low | Moderate-High | Moderate | Moderate | No | Moderate |
| 28 | Fluvaquents | Low | Low | Low | High | No | Low |
| 29 | Fortwingate | Low | Moderate-High | Low | Moderate | No | Moderate |
| 30 | Fortwingate<br>Rock Outcrop | Low | Moderate-High | Low | Moderate | No | Low |
| 32 | Haploborolls | Low | Low | Moderate | None | No | Low |
| | Rubble Land | Low | Low | Low-High | Low-High | No | Low |
| 34 | Harlan | Low | Low-Moderate | Moderate | None | No | Moderate |
| 37 | Herm | Low | Low-High | Low | Low | No | Moderate |
| 39 | Hesperus | Low | Low | Low | Low | Yes | Moderate |
| 42 | Lazear<br>Rock Outcrop | Low | Low | Moderate | None | No | Low |
| 44 | Mikim | | Low | High | Low | No | Moderate |
| 45 | Nebar | Low | Low-Moderate | Low | None | No | Moderate |
| 50[3] | Pescar | Low | Low | Low | Low-Moderate | No | Moderate |
| 53 | Pinata | Low | Low-High | Moderate | Low | No | Low |
| 58 | Rock Outcrop | | | | | | |
| 59 | Sedillo | Low | Low | Low | None | No | Moderate |
| 60 | Shalona | Low | Low-Moderate | Low | Moderate | Yes | High |
| 62 | Sili | Low | Moderate-High | Moderate | Moderate | Yes | Moderate |
| 63 | Sili | Low | Moderate-High | Moderate | Moderate | Yes | Moderate |
| 64 | Simpactico | Low | Low-Moderate | Low | Low | Yes | High |
| 65 | Sycle | Low | Low-Moderate | Low | Low | Yes | High |
| 66 | Tefton | Low | Low | Moderate | None | No | High |
| 70[4] | Ustic Torriorthents<br>Ustollic Haplargids | Low | Low | High | Moderate<br>High | No | Low |
| 74 | Vosburg | Low | Low | Moderate | Moderate | No | Moderate |
| 76 | Witt | Low | Low-Moderate | Moderate | Low | No | Moderate |
| 81 | Zyme | Low | High | High | Moderate | No | Moderate |
| 82 | Zyme<br>Rock Outcrop | Low | High | High | Moderate<br>High | No | Low |
| *Piedra Area Soil Survey* | | | | | | | |
| 4D | Carracas | Low | Low | Moderate | Low | No | Moderate |
| 4E | Carracas | Low | Low | High | Low | No | Low |
| 8E | Chris | Low | Low-Moderate | Moderate | Low | No | Moderate |
| 11E | Corta | Low | Low-High | High | Low | No | Low |
| 12D | Dunton | Low | Low-High | Moderate | Low | No | Moderate |

**Table 3–34 Severity of Hazards for Soils in Project Area**

| Map Unit | Soil Series | Salinity | Shrink/Swell | Water Erosion Hazard | Wind Erosion Hazard | Prime Agriculture Soils | Revegetation Potential |
|---|---|---|---|---|---|---|---|
| 13D | Dunton | Low | Low-High | Moderate | Low | No | Moderate |
| 16D | Greenough | Low | Low-Moderate | Moderate | Low | No | Moderate |
| 19D | Helfin | Low | Low-High | Moderate | Moderate | No | Moderate |
| 22A | Hunchback | Low | High | Low | Low | No | Moderate |
| 22D | Hunchback | Low | High | Low-Moderate | Low | No | Moderate |
| 30E | Mayoworth | Low | Low-High | High | Low | No | Low |
| 36A | Nunn | Low | Moderate-High | Moderate | Low | No | High |
| 36D | Nunn | Low | Moderate-High | Moderate | Low | No | Moderate |
| 39A | Riverwash | Low | Low | Low-High | Low-High | No | Low |

Notes:

1. The 3 Badland, from the Piedra Survey, was merged with 9 Badland from the La Plata Survey.
2. The 11D Corta Silt Loam, from the Piedra Survey, was merged with 23 Corta Loam from the La Plata Survey.
3. The 38A Pescar Sandy Loam, from the Piedra Survey, was merged with 50 Pescar Fine Sandy Loam from the La Plata Survey.
4. The 43 Sandstone Outcrop-Ustorthents Complex, from the Piedra Survey, was merged with 70 Ustic Torriorthents-Ustollic Haplargids Complex from the La Plata Survey.

## 3.7.2.2 CBM Development and Soil Erosion

### *3.7.2.2.1 Concerns*

Clearing vegetation and excavating, compacting, stockpiling, and redistributing soils during construction and reclamation all affect soils. Removal of vegetation exposes soils, making them vulnerable to wind and water erosion. Excavation for facility pads and roads can increase the grade of slopes in cut and fill areas, exposing and loosening soils. Removal and stockpiling of soils for reclamation can mix soil profiles and alter the erosive characteristics. Compaction of the soil can decrease permeability and increase runoff and erosion. Increased erosion can ultimately alter drainage characteristics and water quality if eroded material reaches drainages. Impacted soils identified as having high hazards for wind and water erosion can amplify the effects of CBM development.

### *Wind Erosion Hazard*

Wind erosion groups are based on soil texture (grain size, parent material, cohesiveness, and wetness) and indicate the susceptibility of a soil to wind erosion. Nine groupings have been developed (1, 2, 3, 4, 4L, 5, 6, 7, and 8). The lower the number, the greater the risk of wind erosion. Group 1 includes soils that consist entirely of fine sand, which is highly susceptible to wind erosion. Group 8 contains very wet or stony soils, which are not at all subject to wind erosion. Soils listed in Groups 1 and 2 are considered severe hazards (NRCS 2002).

Severe wind erosion hazards are primarily found in steep areas along ridges and hillsides. The exception is the Fluvaquent soils, which are found in the floors of recent alluvial valleys (Figure 3–30). Figure 3–31 shows the portions of the Project Area where the potential for wind erosion is high.

### Water Erosion Hazard

Water erosion hazards are identified using permeability classes, K-factor, and slope category. Slopes between 25 and 40 percent are considered moderate water erosion hazards and slopes greater than 40 percent are considered severe water erosion hazards, no matter what soil type occurs.

K-factor is one of six factors used in the RUSLE to predict the annual rate of soil loss caused by water erosion. Soil structure, percentage of silt, sand, organic matter, and permeability all affect the K-factor of a soil (Bauer et al. 1981). Values for K range from 0.02 to 0.69. The susceptibility of soil to water erosion increases as the value rises. Soils with low permeability and high K-factors were considered severe water erosion hazards for slope ranges between 0 percent and 25 percent (NRCS 2002).

Water erosion varies considerably among soil types for slopes of 25 percent or less. Therefore, permeability class and K-factor for each soil type are used to identify the soils that might be more susceptible to water erosion on gentle topography. At slopes less than 5 percent, only soils that are the least permeable and have been assigned the highest K-factor are susceptible to water erosion. At slopes greater than 25 percent, only soils that are the most permeable and have been assigned the lowest K-factor are not susceptible to water erosion (NRCS 2002).

Soil permeability classes are assigned by infiltration rates expressed in inches per hour. Rates from 0 to 0.2 inches/hour were considered slow, 0.2 through 6.0 inches/hour moderate, and 6.0 inches/hour and greater were considered rapid (SCS 1994). Generally, rates of infiltration are highest in primarily sandy soils and very slow in clayey soils.

Soils with severe potential for water erosion occur in all types of terrain, from mountainsides and cliffs to valley bottoms. Figure 3–31 shows the portions of the Project Area where the potential for water erosion is high. The guidelines discussed for evaluating water erosion hazards are general; actual loss of soil depends on many other factors, such as vegetative cover, which may make soils more or less susceptible to water erosion than is described.

Soils derived from the Animas Formation, called collapsible, are unique in that they exhibit high potential for dispersion of soil. Soil dispersion is the tendency to go into solution rapidly when exposed to water, which promotes rapid erosion (Poitras and Trautner 2001). These soils are located downslope from areas where the Animas Formation reaches the surface (Figure 3–30), such as drainages in the watersheds of the Florida, Los Pinos, and Piedra Rivers.

RUSLE was used to estimate soil loss for the Project Area to approximate potential sedimentation levels. The five factors used in RUSLE are as follows:

- R, the rainfall and runoff factor for the area;
- K, the soil erodibility factor (discussed previously in the section on water erosion hazard);
- LS, a combination of the slope length and slope steepness;
- C, the cover management factor;

- P, the erosion control practice factor (Renard et al. 1997).

Separate RUSLE calculations were made for each watershed in the Project Area to create a relatively site-specific estimate of soil loss. Boundaries of the watersheds in the Project Area were delineated using HUC 5 coverage for the area. The watershed boundaries are shown on Figure 3–26. All factors except for K and LS were assumed to be constant throughout each watershed. Two values for C were used for each watershed equation. The first value, 0.45, was used to reflect areas where soils are bare and completely exposed, such as access roads or well pads. The second C value, 0.013, was used to reflect areas that contain native vegetative cover and that are unaffected by CBM development. An R-value of 15 was used as a constant for the entire Project Area, obtained from the Isoerodent Map of the Western United States found in the RUSLE handbook. The most conservative factor of 1 for P values (recommended by the RUSLE handbook for areas of irregular slope) was used to represent a worst-case scenario for the erosion control practice. The K value for each watershed was derived by calculating a weighted average of the K factors for each soil type represented in that watershed. The LS values for each watershed were derived by incorporating the average slope percentage within each watershed with a general representative slope length of 500 feet (Redders 2003). Table 3–35 shows the values for K and LS used in the calculations for the various watersheds.

**Table 3–35 Summary of K and LS Values Used in Calculations Made with the Revised Universal Soil Loss Equation**

| Watershed | K Value | LS Value |
|---|---|---|
| Lower Florida River | 0.28 | 2.13 |
| Middle Animas Valley | 0.0.31 | 3.76 |
| Middle Los Pinos River | 0.22 | 3.5 |
| Beaver Creek | 0.26 | 5 |
| Lower Los Pinos River | 0.29 | 6.55 |
| Lower Piedra River | 0.0.13 | 10 |
| Navajo Reservoir Inlet | 0.37 | 5.77 |
| Lower Stollsteimer Creek | 0.23 | 8.46 |

Based on the RUSLE calculation (multiplication of all factors), average annual soil losses vary by watershed (Table 3–36). The Lower Florida River watershed is expected to lose the smallest amount of soil from surface disturbances. In contrast, the Lower Los Pinos River, Navajo Reservoir Inlet, and Stollsteimer Creek watersheds are expected to lose the greatest amount of soil from surface disturbances.

The total annual soil loss expected from existing CBM development disturbance was then estimated by multiplying the estimated soil loss per ton calculated in RUSLE by the acres disturbed by existing CBM facilities. The estimates of annual soil loss by watershed are summarized in Table 3–37. Sixty percent of the estimated annual soil loss generated from existing disturbance occurs in the Beaver Creek and Lower Los Pinos River watersheds. The Lower Piedra River watershed accounts for another 15 percent of the annual soil loss generated from existing disturbance in the Project Area.

## Table 3–36 Summary of Estimated Average Annual Soil Loss for Undisturbed, Vegetated Soils and Bare Soils, by Watershed

| | Average Annual Soil Loss from: (tons/acre) | |
|---|---|---|
| Watershed | Undisturbed Vegetated Soil | Bare Soil |
| Lower Florida River | 0.08 | 2.7 |
| Middle Animas Valley | 0.21 | 7.1 |
| Middle Los Pinos River | 0.15 | 5.2 |
| Beaver Creek | 0.26 | 9.1 |
| Lower Los Pinos River | 0.38 | 13 |
| Lower Piedra River | 0.27 | 9.2 |
| Navajo Reservoir Inlet | 0.42 | 14 |
| Stollsteimer Creek | 0.38 | 13 |

## Table 3–37 Estimated Annual Soil Loss from Existing CBM Disturbance, by Watershed

| Watershed | Existing Surface Disturbance (acres) | Existing Surface Disturbance Within WIZ (acres) | Estimated Annual Soil Loss (tons per acre)[1] | Estimated Annual Soil Loss From Existing Disturbance (tons) | Estimated Annual Soil Loss From Existing disturbance Within WIZ (tons) |
|---|---|---|---|---|---|
| Lower Florida River | 359 | 29 | 2.7 | 969 | 78 |
| Middle Animas Valley | 88 | 7 | 7.1 | 625 | 50 |
| Middle Los Pinos River | 234 | 25 | 5.2 | 1,217 | 130 |
| Beaver Creek | 330 | 61 | 9.1 | 3,003 | 555 |
| Lower Los Pinos River | 296 | 26 | 13 | 3,848 | 338 |
| Lower Piedra River | 176 | 42 | 9.4 | 1,654 | 395 |
| Navajo Reservoir Inlet | 0 | 0 | 14 | 0 | 0 |
| Stollsteimer Creek | 7 | 4 | 13 | 91 | 52 |
| Total[2] | 1,490 | 194 | | 11,407 | 1,638 |

Notes:

1. Based on the calculations in Section 3.7.2.2 for areas that have been cleared of vegetation and the surface soils are exposed.
2. Does not include soil erosion expected to occur naturally from vegetated areas undisturbed by CBM development.

Note: WIZ = watershed influence zone

Sedimentation in rivers and streams in the Project Area is an important result of soil loss, but cannot be adequately estimated simply by calculating soil loss. The sedimentation load depends on whether eroded soil can reach the drainages. Relief, climate, vegetation, and bedrock geology all work to block or facilitate the transport of sediment to surface water. Based on these characteristics, there is a large difference between soil loss and sedimentation in surface water drainages.

Water influence zones (WIZ) were delineated to evaluate areas of elevated soil erosion impacts resulting from CBM surface disturbance within the Project Area. Main drainages (1st order), such as the Animas, Florida, Los Pinos, and Piedra Rivers, were assigned a WIZ of 300 feet on either side. Smaller tributaries (2nd through 7th order), such as Beaver Creek, Saul's Creek, and Springs Creek, were assigned a WIZ of 100 feet on either side. The effects of soil erosion are elevated within the WIZ because eroded sediment is expected to reach the drainages and could cause changes in the quality of the water flowing through the drainage. The WIZ are described in more detail in the Surface Water Resources Section of this chapter.

Approximately 194 acres of existing surface disturbance from CBM development fall within the WIZ in the Project Area.

#### *3.7.2.2.2 Impacts to Date*

Of the acreage disturbed by existing CBM operations, about 42 acres involve soils with high potential for wind erosion and 93 acres involve soils with high potential for water erosion. Soil loss within the Project Area as a result of existing CBM development is estimated to be 11,407 tons per year. The total soil loss expected to have occurred within the WIZ as a result of existing CBM development is approximately 1,638 tons per year (Table 3–37). This loss is in addition to soil losses resulting from natural processes. These effects have, however, been minimized using BMPs. Loss of soil caused by wind and water erosion has been reduced by revegetating portions of well pads not needed for production immediately after construction. Maintaining original flow patterns as much as possible and installing slope breaks and silt fences on slopes near CBM facilities has also minimized soil loss caused by water erosion.

### 3.7.2.3 CBM Development and Topsoil Loss

#### *3.7.2.3.1 Concerns*

Loss of topsoil has already been discussed in Section 3.7.2.2. However, in addition to sedimentation and decreasing slope stability, the loss of topsoil is important in its negative effect on forestry, agriculture, and wildlife. These effects are mostly related not to the loss of topsoil itself, but to the loss of soil productivity. In addition, the potential for revegetation during reclamation becomes the central issue in considering the effects of soil loss as well pads and roads are completely cleared of vegetation during development of CBM and are eventually reclaimed. Two categories related to soil productivity, potential for revegetation and prime farmland, are identified in the soil surveys. Figure 3–32 shows the portions of the Project Area where revegetation potential is low and where prime farmland is designated.

##### *Potential for Revegetation*

The potential for revegetation of soils was evaluated using the land capability classification. Soils were grouped according to limitations for field crops, risk of damage if used for agriculture, and response to management. Capability classes were divided into eight groups (Roman numerals I through VIII), with few limitations for Class I soils and multiple limitations that prevent commercial crop production for Class VIII soils. Class VII and Class VIII soils have been determined to have poor potential for revegetation (NRCS 2002).

Soils with poor revegetation potential are shallow, rocky soils, which occur primarily in steep areas, such as canyon walls, mesa edges, ridges, and hillsides.

The exception is the Fluvaquent soils, which are found in recent alluvial valley floors (see Figure 3–30).

#### Prime Farmland

The prime farmland designation is based on the soil type, regardless of current land use. The U.S. Department of Agriculture (USDA) has identified and located lands of national importance, including prime and unique farmlands, and farmlands of state and local importance.

Prime and unique farmlands and farmlands of state and local importance located within Colorado are delineated in the La Plata Survey. The Piedra Area Survey did not list prime farmlands, but the lack of irrigation in the area precludes soils in this survey from classification as prime farmland (Bauer et al. 1981).

Irrigation in the Project Area occurs along the Los Pinos and Florida Rivers. Only the irrigated soils in a small area along the upper section of the Florida River in the Project Area and near Bayfield are considered prime farmland.

#### 3.7.2.3.2 Impacts to Date

Of the acreage disturbed by existing CBM operations, about 134 acres are on soils with poor potential for revegetation and 52 acres are on prime agricultural soils. There is a greater potential for topsoil loss in the areas where revegetation is unsuccessful because the soils remain vulnerable to wind and water erosion. Prime farmland is removed from productivity or the future potential to be productive when CBM facilities are constructed on the soils. These effects on disturbed soils with low potential for revegetation and on prime farmland have been minimized using BMPs (Appendix F), such as seeding with aggressive, stabilizing plant species.

## 3.7.3 Environmental Consequences

### 3.7.3.1 Impacts Common to All Alternatives

Short-term and long-term soils impacts would result from various activities during the construction, drilling, production, and reclamation phases of the project. These potential effects are evaluated on the basis of maximum estimated surface disturbance for each alternative, which was calculated using approximate locations of gas well pads, access roads, pipelines, produced water disposal wells, trunk pipelines, and compressor stations. Short-term and long-term surface disturbance is also a function of the number of wells the companies drill from each pad. During construction, tractor dozers, tractor backhoes, and road graders would strip the area of vegetation, dig and stockpile topsoil for reclamation, and then roughly grade the general contour of the road, pad, or pipeline ROW using standard cut-and-fill techniques. Gravel trucks would transport and place coarse subsurface gravel and finer surface gravel on the road surfaces and the areas of the pads where heavy equipment would be used.

Activities and conditions that would cause long-term impacts to soils include periodic maintenance of access roads and routine daily inspection and maintenance of gas wells, injection wells, compressor stations, and pipelines. Routine maintenance of access roads could involve additions of gravel and blading in the summer and blading of snow and some additions of gravel where necessary and permitted by weather conditions in the winter. When the project is complete, all roads constructed specifically for the project would be removed and reclaimed by re-contouring, plowing, and seeding. All surface facilities and gravel surfaces on the gas well pads, compression station pads, and injection well pads would be removed. Topsoil that was stockpiled previously would be spread on the disturbed portions of the pads. Erosion control features would be installed as necessary. Underground gas and produced water pipelines and electric transmission lines would be abandoned in place to avoid unnecessary disturbance of the surface soil.

Following are discussions of estimated short-term and long-term soil under each alternative. Table 3–38 summarizes the estimated surface disturbance associated with each soil hazard identified as an issue of concern.

**Table 3–38 Summary of Effects to High-hazard Soils, by Alternative**

| | | Soils Hazards | | | |
|---|---|---|---|---|---|
| | Total Surface Disturbance[1] | Water Erosion | Wind Erosion | Poor Revegetation | Prime Farmland |
| Existing | 1,496 | 93 | 42 | 134 | 53 |
| Alternative 1 | | | | | |
| Short Term | 1,113 | 147 | 51 | 365 | 24 |
| Long term | 684 | 97 | 34 | 243 | 16 |
| Alternative 1A | | | | | |
| Short Term | 965 | 119 | 46 | 303 | 24 |
| Long term | 630 | 79 | 31 | 210 | 16 |
| Alternative 1B | | | | | |
| Short Term | 690 | 83 | 46 | 230 | 24 |
| Long term | 484 | 55 | 31 | 164 | 16 |
| Alternative 2 | | | | | |
| Short Term | 1,843 | 327 | 92 | 664 | 39 |
| Long term | 1,171 | 216 | 62 | 444 | 27 |
| Alternative 3 | | | | | |
| Short Term | 756 | 96 | 49 | 296 | 24 |
| Long term | 474 | 64 | 33 | 198 | 16 |
| Alternative 4 | | | | | |
| Short Term | 766 | 108 | 50 | 267 | 24 |
| Long term | 478 | 72 | 34 | 178 | 16 |
| Alternative 5 | | | | | |
| Short Term | 422 | 66 | 44 | 151 | 24 |
| Long term | 253 | 45 | 30 | 102 | 16 |

Note:

1. Disturbances were calculated based on the maximum surface disturbance of each CBM facility on soils that may exhibit more than one type of hazard characteristic. Therefore, the total acreage of all hazard characteristics may not add up to the total disturbance for each alternative. The total disturbances for each hazard under each alternative also do not include acres for some roads where locations have not been determined.

## 3.7.3.2 CBM Development and Soil Erosion

### *3.7.3.2.1 Alternative 1 — Proposed Action*

Construction of CBM facilities would result in exposed soils and increase erosion the potential, especially in areas that contain soils with high potential for water and wind erosion. Increased erosion may ultimately alter drainage characteristics and water quality if eroded sediment reaches drainages. Aquatic wildlife habitats, some domestic drinking water supplies, and irrigation systems, may be affected by this sedimentation.

During construction, Alternative 1 would impact 147 acres with high potential for water erosion and 51 acres of soils with high potential for wind erosion, with some overlap of soils exhibiting both hazards (Table 3–38). During operation and maintenance, Alternative 1 would impact 97 acres with high water erosion potential and 34 acres of soils with high wind erosion potential. These erosive soils are mostly concentrated in the western portion of the Project Area, between the western boundary of the Fruitland Outcrop and Bayfield, southeast of County Road 502, as well as in the HD Mountains and along the drainages of the Florida, Piedra, and Los Pinos Rivers and their tributaries (Figure 3–31). There are also patches of wind and water erosive soils west of the La Plata County line and south of Bayfield. Construction, operation, and decommissioning of CBM facilities would cause greater soil erosion in these areas than in areas with lower potential for wind and water erosion. Heavy equipment traffic over barren and exposed soils on well pads, access roads, and other CBM facilities would loosen erosive soils, making them even more vulnerable to transport off site by water and wind.

The total soil loss expected during construction is estimated using RUSLE and the acreage impacted in each watershed. Table 3–39 shows the estimated amount of soil erosion within each watershed as a result of Alternative 1.

A total of 30,302 tons of soil are estimated to erode naturally from undisturbed portions of the Project Area each year. Alternative 1 would increase this level of erosion by 9,763 tons per year (32 percent) during the construction phase of the project. Eighty-seven percent of the soil projected to erode during construction would occur within the Beaver Creek, Lower Los Pinos River, and Lower Piedra River watersheds, encompassing all of the HD Mountains. The Middle Animas watershed would experience the least amount of soil erosion. With partial reclamation of disturbed areas, erosion would equal approximately 6,437 tons per year (21 percent) increase over existing conditions during the operation and maintenance phase of the project (Table 3–39). Similar to the construction phase, the Beaver Creek, Lower Los Pinos River, and Lower Piedra River watersheds would experience the greatest amount of soil erosion during operation and maintenance. The potential for soil loss, therefore, would be greatest in the HD Mountains area.

Alternative 1 would result in surface disturbance and erosion in almost all WIZ (Table 3–39). Ninety-four acres of WIZ (9 percent of the total surface disturbance under Alternative 1) would be impacted during the construction phase of the project, resulting in 879 tons of soil erosion per year. After partial reclamation, approximately 565 tons of soil erosion would occur per year, or 9 percent of the total soil expected to erode as a result of activities under Alternative 1. A significant portion of the soil eroded from the WIZ could reach surface water drainages in the absence of mitigation, and may impair water quality, and potentially impact aquatic wildlife habitats, some domestic drinking water supplies, and irrigation systems. The effects to water quality are discussed in more detail in the Surface Water section of this chapter. The potential for soil loss and sedimentation impacting surface water would be greatest in the HD Mountains area.

**Table 3–39 Estimated Annual Soil Loss by Watershed resulting from Alternative 1**

| Watershed | Short-Term Disturbance (acres) | Short-Term Disturbance in WIZ (acres) | Long-Term Disturbance (acres) | Long-Term Disturbance in WIZ (acres) | Estimated Annual Soil Loss (tons per acre)[1] | Annual Short-Term Soil Loss (tons) | Annual Short-Term Soil Loss in WIZ (tons) | Annual Long-Term Soil Loss (tons) | Annual Long-Term Soil Loss in WIZ (tons) |
|---|---|---|---|---|---|---|---|---|---|
| Lower Florida River | 53 | 6 | 36 | 4 | 2.7 | 143 | 16 | 97 | 11 |
| Middle Animas Valley | 13 | 0 | 10 | 0 | 7.1 | 92 | 0 | 71 | 0 |
| Middle Los Pinos River | 65 | 8 | 45 | 5 | 5.2 | 338 | 42 | 234 | 26 |
| Beaver Creek | 144 | 12 | 97 | 9 | 9.1 | 1,310 | 109 | 883 | 82 |
| Lower Los Pinos River | 201 | 9 | 137 | 6 | 13 | 2,613 | 117 | 1,781 | 78 |
| Lower Piedra River | 487 | 55 | 313 | 35 | 9.4 | 4,578 | 517 | 2,942 | 329 |
| Navajo Reservoir Inlet | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 |
| Stollsteimer Creek | 53 | 6 | 33 | 3 | 13 | 689 | 78 | 429 | 39 |
| Total[2] | 1016 | 94 | 672 | 62 |  | 9,763 | 879 | 6,437 | 565 |

Notes:

1. Based on the calculations in Section 3.7.2.2 for areas that have been cleared of vegetation and the surface soils are exposed.
2. Totals for short and long-term disturbance do not include acreages of disturbance predicted from windows for yet undetermined road locations (See Table 2–1 in Chapter 2). Totals for short and long-term erosion do not include soil erosion expected to occur naturally from vegetated areas undisturbed by CBM development

Soil erosion would be limited by implementing standard mitigation measures, which are described in Section 3.7.5 and Appendix F. These measures include slope breakers, silt fencing, drainage dips, timely reclamation, and seeding of stockpiles that remain for extended periods. Road and well pad surfaces would be graveled to mitigate wind erosion. Heavy equipment would not be allowed on federal lands, other than on main service roads or when the soil is saturated (that is, when the moisture content exceeds the plastic limit), which would limit water erosion on exposed soils. CBM-related vehicular traffic would be limited to the traveled surfaces of access roads identified in the APD.

### *3.7.3.2.2 Alternative 1A*

Alternative 1A would impact 68 acres of soils with high potential for water erosion (24 acres less than Alternative 1) and 90 acres of soils with high potential for wind erosion (same as Alternative 1) during construction (Table 3–38). During operation and maintenance, 79 acres of soils with high potential for water erosion (18 acres less than Alternative 1) and 31 acres of soils with high potential for wind erosion (3 acres less than Alternative 1) would be impacted. The potential for wind and water erosion throughout the Project Area as a whole under Alternative 1A would, therefore, be slightly less than under Alternative 1, particularly in the HD Mountains, where the number of well pads would be limited by using directional short-reach drilling methods.

Alternative 1A would result in less surface disturbance than Alternative 1 within the Beaver Creek, Lower Los Pinos River, Lower Piedra River, and Stollsteimer Creek watersheds (Table 3–39 and Table 3–40), where the majority of the severe slopes in the Project Area exist. Overall, 92 acres of surface disturbance would

**Table 3–40 Estimated Annual Soil Loss by Watershed resulting from Alternative 1A**

| Watershed | Short-Term Disturbance (acres) | Short-Term Disturbance in WIZ (acres) | Long-Term Disturbance (acres) | Long-Term Disturbance in WIZ (acres) | Estimated Annual Soil Loss (tons per acre)[1] | Annual Short-Term Soil Loss (tons) | Annual Short-Term Soil Loss in WIZ (tons) | Annual Long-Term Soil Loss (tons) | Annual Long-Term Soil Loss in WIZ (tons) |
|---|---|---|---|---|---|---|---|---|---|
| Lower Florida River | 53 | 6 | 36 | 4 | 2.7 | 143 | 16 | 97 | 11 |
| Middle Animas Valley | 13 | 0 | 10 | 0 | 7.1 | 92 | 0 | 71 | 0 |
| Middle Los Pinos River | 65 | 8 | 45 | 5 | 5.2 | 338 | 42 | 234 | 26 |
| Beaver Creek | 127 | 16 | 94 | 11 | 9.1 | 1,156 | 146 | 855 | 100 |
| Lower Los Pinos River | 181 | 9 | 133 | 7 | 13 | 2,353 | 117 | 1,729 | 91 |
| Lower Piedra River | 388 | 48 | 270 | 33 | 9.4 | 3,647 | 451 | 2,538 | 310 |
| Navajo Reservoir Inlet | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 |
| Stollsteimer Creek | 42 | 5 | 29 | 4 | 13 | 546 | 65 | 377 | 52 |
| Total[2] | 869 | 92 | 617 | 63 |  | 8,275 | 842 | 5,834 | 590 |

Notes:

1. Based on the calculations in Section 3.7.2.2 for areas that have been cleared of vegetation and the surface soils are exposed.
2. Totals for short and long-term disturbance do not include acreages of disturbance predicted from windows for yet undetermined road locations (See Table 2–3 in Chapter 2). Totals for short and long-term erosion do not include soil erosion expected to occur naturally from vegetated areas undisturbed by CBM development

occur within WIZ (3 acres less than Alternative 1) during construction, and 63 acres would remain impacted within WIZ (1 acre more than Alternative 1) during operation and maintenance. Table 3–40 shows the estimated annual soil loss by watershed as a result of Alternative 1A. Projected additional soil erosion above baseline from all impacted portions of the Project Area would be 8,275 tons per year during construction and 5,834 tons per year during operation and maintenance. Approximately 842 tons of soil would be expected to erode annually as a result of construction in WIZ (37 tons less than Alternative 1). Five hundred and ninety tons of soil are projected to erode annually during operation and maintenance within WIZ (25 tons more than Alternative 1). The potential for surface water sedimentation would therefore be less under Alternative 1A when compared with Alternative 1.

### *3.7.3.2.3 Alternative 1B*

Alternative 1B would impact 83 acres of soils with high potential for water erosion (64 acres less than Alternative 1) and 46 acres of soils with high potential for wind erosion (5 acres less than Alternative 1) during construction (Table 3–38). During operation and maintenance, 55 acres of soils with high potential for water erosion (42 acres less than Alternative 1) and 31 acres on soils with high wind erosion potential (3 acres less than Alternative 1) would be impacted. The potential for wind and water erosion would, therefore, be significantly less than Alternative 1, particularly in the HD Mountains, where the number of well pads would be limited by using directional long-reach drilling methods.

Alternative 1B would decrease disturbance in the Beaver Creek, Lower Los Pinos River, Lower Piedra River, and Stollsteimer Creek watersheds (Table 3–39 and Table 3–41), where most of the severe slopes occur within the Project Area and within WIZ. Fifty-seven acres within the WIZ would be impacted during construction (37 acres less than Alternative 1), and 40 acres within the WIZ would be impacted during operation and maintenance (22 acres less than Alternative 1). Table 3–41 shows the Alternative 1B estimated annual soil loss by watershed. In total, 508 tons of soil is projected to erode from WIZ annually during construction (371 tons less than Alternative 1), and 359 tons would be expected to erode from WIZ annually during operation and maintenance (206 tons less than Alternative 1). Potential surface water quality impacts resulting from sedimentation, therefore, would be less than both Alternatives 1 and 1A, particularly because of the reduced surface disturbance within WIZ.

### *3.7.3.2.4 Alternative 2*

Alternative 2 would result in greater soil erosion than Alternative 1, because of the higher level of development and impact to areas prone to erosion. Alternative 2 would impact 327 acres of soils with high potential for water erosion and 92 acres of soils with high potential for wind erosion in the short term (with some overlap on soils that exhibit both characteristics). Two hundred sixteen acres of soils with high potential for water erosion and 62 acres of soils with high potential for wind erosion (with some overlap) would remain impacted in the long term after partial reclamation. Soil loss would be mitigated partially by limiting CBM-related vehicular traffic to the access roads; wetting down and compacting access road surfaces where dust is an issue; revegetating soil stockpiles that would remain for long periods; installing erosion control devices (slope breakers and silt fences) on slopes where soils are exposed; and reclaiming impacted surfaces in a timely manner.

**Table 3–41 Estimated Annual Soil Loss by Watershed resulting from Alternative 1B**

| Watershed | Short-Term Disturbance (acres) | Short-Term Disturbance in WIZ (acres) | Long-Term Disturbance (acres) | Long-Term Disturbance in WIZ (acres) | Estimated Annual Soil Loss (tons per acre)[1] | Annual Short-Term Soil Loss (tons) | Annual Short-Term Soil Loss in WIZ (tons) | Annual Long-Term Soil Loss (tons) | Annual Long-Term Soil Loss in WIZ (tons) |
|---|---|---|---|---|---|---|---|---|---|
| Lower Florida River | 53 | 6 | 36 | 4 | 2.7 | 143 | 16 | 97 | 11 |
| Middle Animas Valley | 13 | 0 | 10 | 0 | 7.1 | 92 | 0 | 71 | 0 |
| Middle Los Pinos River | 65 | 8 | 45 | 5 | 5.2 | 338 | 42 | 234 | 26 |
| Beaver Creek | 114 | 11 | 90 | 8 | 9.1 | 1,037 | 100 | 819 | 73 |
| Lower Los Pinos River | 152 | 6 | 110 | 4 | 13 | 1,976 | 78 | 1,430 | 52 |
| Lower Piedra River | 228 | 22 | 176 | 14 | 9.4 | 2,143 | 207 | 1,654 | 132 |
| Navajo Reservoir Inlet | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 |
| Stollsteimer Creek | 9 | 5 | 7 | 5 | 13 | 117 | 65 | 91 | 65 |
| Total[2] | 634 | 58 | 474 | 40 |  | 5,846 | 508 | 4,396 | 359 |

Notes:

1. Based on the calculations in Section 3.7.2.2 for areas that have been cleared of vegetation and the surface soils are exposed.
2. Totals for short and long-term disturbance do not include acreages of disturbance predicted from windows for yet undetermined road locations (See Table 2–4 in Chapter 2). Totals for short and long-term erosion do not include soil erosion expected to occur naturally from vegetated areas undisturbed by CBM development

Table 3–42 shows the estimated annual tons of soil erosion within each watershed as a result of Alternative 2. An estimated 30,113 tons of soil are estimated to erode naturally from undisturbed portions of the Project Area each year. Alternative 2 would increase erosion by 16,265 tons per year (54 percent) during the construction phase of the project. With partial reclamation, erosion would drop to 10,787 tons per year (36 percent) over existing conditions during the operation and maintenance phase of the project (Table 3–42).

Alternative 2 would result in surface disturbance and erosion in almost all WIZs (Table 3–42). One hundred and sixty five acres of WIZ would be impacted during the construction phase of the Project. About 1,553 tons of soil per year would erode from WIZs as a result of construction activities. After partial reclamation, there would be 150 acres remaining impacted during the operation and maintenance phase and an expected 1,029 tons of soil eroded per year within the WIZs. A portion of the soil eroded from the WIZ would be expected to reach surface water drainages and may impair water quality. The potential for soil erosion within the WIZ and the potential for that eroded soil to impact surface water quality would be significantly greater under Alternative 2 than Alternative 1.

### 3.7.3.2.5 Alternative 3

Alternative 3 erosion levels would be less than Alternative 1 because well development in the HD Mountains Inventoried Roadless Area would be eliminated. Alternative 3 would impact 96 acres of soils with high potential for water erosion and 49 acres on soils with high potential for wind erosion (with some overlap on soils exhibiting both hazards) during construction. The Alternative would continue to impact 64 acres of soils with high water erosion potential and 33 acres on soils with high wind erosion potential after partial reclamation (with some overlap) during operation and maintenance.

**Table 3–42 Estimated Annual Soil Loss by Watershed resulting from Alternative 2**

| Watershed | Short-Term Disturbance (acres) | Short-Term Disturbance in WIZ (acres) | Long-Term Disturbance (acres) | Long-Term Disturbance in WIZ (acres) | Estimated Annual Soil Loss (tons per acre)[1] | Annual Short-Term Soil Loss (tons) | Annual Short-Term Soil Loss in WIZ (tons) | Annual Long-Term Soil Loss (tons) | Annual Long-Term Soil Loss in WIZ (tons) |
|---|---|---|---|---|---|---|---|---|---|
| Lower Florida River | 138 | 13 | 93 | 9 | 2.7 | 373 | 35 | 251 | 24 |
| Middle Animas Valley | 71 | 0 | 49 | 0 | 7.1 | 504 | 0 | 348 | 0 |
| Middle Los Pinos River | 122 | 13 | 84 | 9 | 5.2 | 634 | 68 | 437 | 47 |
| Beaver Creek | 404 | 38 | 270 | 27 | 9.1 | 3,676 | 346 | 2,457 | 246 |
| Lower Los Pinos River | 379 | 35 | 256 | 23 | 13 | 4,927 | 455 | 3,328 | 299 |
| Lower Piedra River | 570 | 58 | 368 | 37 | 9.4 | 5,358 | 545 | 3,459 | 348 |
| Navajo Reservoir Inlet | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 |
| Stollsteimer Creek | 61 | 8 | 39 | 5 | 13 | 793 | 104 | 507 | 65 |
| Total[2] | 1,745 | 165 | 1,359 | 150 |  | 16,265 | 1,553 | 10,787 | 1,029 |

Notes:

1. Based on the calculations in Section 3.7.2.2 for areas that have been cleared of vegetation and the surface soils are exposed.
2. Totals for short and long-term disturbance do not include acreages of disturbance predicted from windows for yet undetermined road locations (See Table 2–5 in Chapter 2). Totals for short and long-term erosion do not include soil erosion expected to occur naturally from vegetated areas undisturbed by CBM development.

Table 3–43 shows the estimated annual tons of soil loss within each watershed as a result of Alternative 3 CBM development. An estimated 30,392 tons of soil are expected to erode naturally from undisturbed portions of the Project Area each year. Alternative 3 would increase erosion by 6,615 tons per year (22 percent) during the construction phase of the project. Partial reclamation would reduce erosion to 4,412 tons per year (15 percent) over existing conditions during the operation and maintenance phase of the project (Table 3–43). Soil erosion would be 3,148 tons per year less than Alternative 1 (32 percent less). The Beaver Creek, Lower Los Pinos, and Lower Piedra River watersheds would experience less surface disturbance and less soil erosion per year than under Alternative 1. The disturbance and erosion expected in all other watersheds would be the same as Alternative 1.

Alternative 3 would impact 70 WIZ acres during construction, resulting in about 644 tons of soil erosion per year. Forty-six acres of WIZ would remain impacted during the operation and maintenance phases of the project. Four hundred and fifteen tons of soil per year would be expected to erode from WIZ during the operation and maintenance phase. The Lower Piedra River and Beaver Creek watersheds would experience less short-term and long-term disturbance and soil loss within the WIZ than Alternative 1.

### 3.7.3.2.6 Alternative 4

The potential for soil erosion under Alternative 4 would be less, in general, than under Alternative 1. Alternative 4 would impact 108 acres on soils with high potential for water erosion and 50 acres on soils with high potential for wind erosion during construction. Following partial reclamation, Alternative 4 would continue to impact 72 acres on soils with high water erosion potential and 34 acres on soils with high wind erosion potential during operation and maintenance.

**Table 3–43 Estimated Annual Soil Loss by Watershed resulting from Alternative 3**

| Watershed | Short-Term Disturbance (acres) | Short-Term Disturbance in WIZ (acres) | Long-Term Disturbance (acres) | Long-Term Disturbance in WIZ (acres) | Estimated Annual Soil Loss (tons per acre)* | Annual Short-Term Soil Loss (tons) | Annual Short-Term Soil Loss in WIZ (tons) | Annual Long-Term Soil Loss (tons) | Annual Long-Term Soil Loss in WIZ (tons) |
|---|---|---|---|---|---|---|---|---|---|
| Lower Florida River | 53 | 6 | 36 | 4 | 2.7 | 143 | 16 | 97 | 11 |
| Middle Animas Valley | 13 | 0 | 10 | 0 | 7.1 | 92 | 0 | 71 | 0 |
| Middle Los Pinos River | 65 | 8 | 45 | 5 | 5.2 | 338 | 42 | 234 | 26 |
| Beaver Creek | 109 | 11 | 74 | 8 | 9.1 | 992 | 100 | 673 | 73 |
| Lower Los Pinos River | 159 | 9 | 108 | 6 | 13 | 2,067 | 117 | 1,404 | 78 |
| Lower Piedra River | 244 | 31 | 160 | 20 | 9.4 | 2,294 | 291 | 1,504 | 188 |
| Navajo Reservoir Inlet | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 |
| Stollsteimer Creek | 53 | 6 | 33 | 3 | 13 | 689 | 78 | 429 | 39 |
| Total** | 696 | 71 | 466 | 46 |  | 6,615 | 644 | 4,412 | 415 |

Notes:

1. Based on the calculations in Section 3.7.2.2 for areas that have been cleared of vegetation and the surface soils are exposed.
2. Totals for short and long-term disturbance do not include acreages of disturbance predicted from windows for yet undetermined road locations (See Table 2–7 in Chapter 2). Totals for short and long-term erosion do not include soil erosion expected to occur naturally from vegetated areas undisturbed by CBM development.

Table 3–44 shows the estimated annual tons of soil expected to erode annually within each watershed as a result of CBM development under Alternative 4. In addition estimated 30,390 tons background erosion in the Project Area each year, Alternative 4 would increase erosion by 6,722 tons per year (22 percent) during the construction phase of the project. With partial reclamation of disturbed areas, erosion would drop to 4,454 tons per year (15 percent) over existing conditions during the operation and maintenance phase of the project (Table 3–44). The Lower Piedra River and Stollsteimer Creek watersheds would experience less surface disturbance under Alternative 4 than Alternative 1, which accounts for the decrease in total annual estimated soil erosion.

Alternative 4 would result in surface disturbance and potential erosion in almost all of the WIZs (Table 3–44). The surface disturbance and soil erosion in the Beaver Creek and Lower Los Pinos watersheds would be greater within the WIZ than under Alternative 1; however, there would be no surface disturbance in the Stollsteimer Creek watershed under Alternative 4. Total erosion in the WIZ would be very similar to Alternative 1 (Table 3–39 and Table 3–44). Ninety-three acres would be disturbed within the WIZ during the construction phase of the project, resulting in 857 tons of soil per year erosion in the WIZ. The quantity of soil expected to erode from WIZ during the operation and maintenance phase would be 571 tons per year. The potential for sedimentation in surface water resources and negative impacts to water quality is greater under Alternative 4 than Alternative 1 in the Beaver Creek and Lower Los Pinos River watersheds.

**Table 3–44 Estimated Annual Soil Losses by Watershed resulting from Alternative 4**

| Watershed | Short-Term Disturbance (acres) | Short-Term Disturbance in WIZ (acres) | Long-Term Disturbance (acres) | Long-Term Disturbance in WIZ (acres) | Estimated Annual Soil Loss (tons per acre)[1] | Annual Short-Term Soil Loss (tons) | Annual Short-Term Soil Loss in WIZ (tons) | Annual Long-Term Soil Loss (tons) | Annual Long-Term Soil Loss in WIZ (tons) |
|---|---|---|---|---|---|---|---|---|---|
| Lower Florida River | 53 | 6 | 36 | 4 | 2.7 | 143 | 16 | 97 | 11 |
| Middle Animas Valley | 10 | 0 | 7 | 0 | 7.1 | 71 | 0 | 50 | 0 |
| Middle Los Pinos River | 65 | 8 | 45 | 5 | 5.2 | 338 | 42 | 234 | 26 |
| Beaver Creek | 145 | 18 | 96 | 13 | 9.1 | 1,320 | 164 | 874 | 118 |
| Lower Los Pinos River | 201 | 17 | 134 | 11 | 13 | 2,613 | 221 | 1,742 | 143 |
| Lower Piedra River | 238 | 44 | 155 | 29 | 9.4 | 2,237 | 414 | 1,457 | 273 |
| Navajo Reservoir Inlet | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 |
| Stollsteimer Creek | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 |
| Total[2] | 712 | 93 | 473 | 62 | | 6,722 | 857 | 4,454 | 571 |

Notes:

1. Based on the calculations in Section 3.7.2.2 for areas that have been cleared of vegetation and the surface soils are exposed.
2. Totals for short and long-term disturbance do not include acreages of disturbance predicted from windows for yet undetermined road locations (See Table 2–8 in Chapter 2). Totals for short and long-term erosion do not include soil erosion expected to occur naturally from vegetated areas undisturbed by CBM development.

#### 3.7.3.2.7 Alternative 5 — No Action

Alternative 5 would impact 66 acres of soils with high potential for water erosion and 44 acres of soils with high potential for wind erosion (with some overlap on soils exhibiting both hazards) during the construction phase of the project The potential for soil erosion caused by water and wind would be the lowest of all alternatives, because additional CBM development would not proceed on federal leases at this time.

Table 3–45 shows the estimated annual tons of soil erosion within each watershed as a result of Alternative 5. An estimated 30,494 tons of soil are expected to erode naturally from undisturbed portions of the Project Area each year. Alternative 5 would increase erosion by an estimated 3,108 tons per year (10 percent) during the construction phase of the project. With partial reclamation erosion would drop to 2,091 tons per year (7 percent) over existing conditions during the operation and maintenance phase of the project (Table 3–45).

Fifty acres would be disturbed within the WIZ during the construction phase of the project, resulting in 431 tons per year of erosion. The potential for soil erosion and subsequent impairment of surface water quality would be lowest under Alternative 5.

### 3.7.3.3 CBM Development and Topsoil Loss

#### 3.7.3.3.1 Alternative 1 — Proposed Action

Aside from decreasing soil stability and increasing sedimentation, the loss of soils could negatively affect forestry, agriculture, and wildlife habitats. Revegetation potential is an important issue when considering the effects of soil loss during reclamation because absent partial or total reclamation soils would be exposed and vulnerable to erosion for many years.

**Table 3–45 Estimated Annual Soil Loss by resulting from Alternative 5**

| Watershed | Short-Term Disturbance (acres) | Short-Term Disturbance in WIZ (acres) | Long-Term Disturbance (acres) | Long-Term Disturbance in WIZ (acres) | Estimated Annual Soil Loss (tons per acre)* | Annual Short-Term Soil Loss (tons) | Annual Short-Term Soil Loss in WIZ (tons) | Annual Long-Term Soil Loss (tons) | Annual Long-Term Soil Loss in WIZ (tons) |
|---|---|---|---|---|---|---|---|---|---|
| Lower Florida River | 44 | 3 | 30 | 2 | 2.7 | 119 | 8 | 81 | 5 |
| Middle Animas Valley | 13 | 0 | 10 | 0 | 7.1 | 92 | 0 | 71 | 0 |
| Middle Los Pinos River | 62 | 8 | 43 | 5 | 5.2 | 322 | 42 | 224 | 26 |
| Beaver Creek | 54 | 11 | 37 | 8 | 9.1 | 491 | 100 | 337 | 73 |
| Lower Los Pinos River | 88 | 5 | 59 | 4 | 13 | 1,144 | 65 | 767 | 52 |
| Lower Piedra River | 100 | 23 | 65 | 15 | 9.4 | 940 | 216 | 611 | 141 |
| Navajo Reservoir Inlet | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 |
| Stollsteimer Creek | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 |
| Total** | 362 | 50 | 244 | 34 |  | 3,108 | 431 | 2,091 | 297 |

Notes:

1. Based on the calculations in Section 3.7.2.2 for areas that have been cleared of vegetation and the surface soils are exposed.
2. Totals for short and long-term disturbance do not include acreages of disturbance predicted from windows for yet undetermined road locations (See Table 2–9 in Chapter 2). Totals for short and long-term erosion do not include soil erosion expected to occur naturally from vegetated areas undisturbed by CBM development.

During construction, 365 acres of soils with poor potential for revegetation would be impacted and about 243 acres would remain unreclaimed during the operational and maintenance phase of the project. This impact would be realized mostly in the western portion of the Project Area between the Florida and Los Pinos Rivers. Revegetation during facility reclamation could be difficult in these areas, thus, erosion could continue beyond the life of the project.

Alternative 1 would impact 24 acres of prime farmlands along the upper section of the Florida River and near Bayfield. About 16 acres of prime farmlands would remain unreclaimed during the operational and maintenance phase of the project. Impacted prime farmlands would be removed from their prior agricultural use or from the potential to be used for agricultural purposes for the life of the project.

#### 3.7.3.3.2 Alternative 1A

Alternative 1A would impact fewer soils with low potential for revegetation than Alternative 1, but would impact temporarily or permanently the same amount of prime farmland as Alternative 1 (Table 3–38). Alternative 1A would impact 303 acres of soils with low potential for revegetation (62 acres less than Alternative 1) and 24 acres of prime farmland (the same acreage as Alternative 1). During the operation and maintenance phase, 210 acres of soils with poor potential for revegetation (33 acres less than Alternative 1) and 16 acres of prime farmland (the same acreage as Alternative 1) would be impacted by CBM development. Alternative 1A revegetation would be slightly more successful than Alternative 1 because less surface area would be disturbed on soils with low potential for revegetation.

#### 3.7.3.3.3 Alternative 1B

Alternative 1B would impact fewer soils with low potential for revegetation than Alternative 1 (Table 3–38). Alternative 1B would impact temporarily or permanently the same amount of prime farmland as Alternative 1. Alternative 1B would impact 230 acres of soils with low potential for revegetation (135 acres less than Alternative 1) and 24 acres of prime farmland (the same acreage as Alternative 1). During the operation and maintenance phase, 164 acres of soils with poor potential for revegetation (79 acres less than Alternative 1) and 16 acres of prime farmland (the same acreage as Alternative 1) would be impacted by CBM development. Alternative 1B reclamation would be more successful than Alternative 1 because a much smaller surface area would be impacted on soils with low potential for revegetation.

#### 3.7.3.3.4 Alternative 2

Alternative 2 topsoil losses would be greater than Alternative 1. Construction would impact about 664 acres of soils with poor potential for revegetation and 39 acres of soils identified as prime farmland. About 444 acres of soils with poor potential for revegetation and 27 acres of soils classified as prime farmlands would remain impacted during the operational and maintenance phase of the project.

#### *3.7.3.3.5 Alternative 3*

Alternative 3 topsoil loss would be less than Alternative 1 because well development in the HD Mountains Inventoried Roadless Area would be eliminated. Otherwise, Alternative 3 presents the same pattern of development as Alternative 1. Construction would impact about 296 acres of soils with poor potential for revegetation and 24 acres of prime farmland. About 198 acres of soils with poor potential for revegetation and 16 acres of prime farmland would remain impacted during the operational and maintenance phase of the project.

#### *3.7.3.3.6 Alternative 4*

Alternative 4 topsoil loss would be less than Alternative 1 because of the lower density of CBM development in the HD Mountains. The project would disturb about 267 acres of soils with poor potential for revegetation and 24 acres of prime farmland. About 178 acres of soils with poor potential for revegetation and 16 acres of prime farmland would remain impacted during the operational and maintenance phase of the project.

#### *3.7.3.3.7 Alternative 5 — No Action*

The potential for topsoil loss would be the least of all the alternatives. Project construction would impact about 151 acres of soils with poor potential for revegetation and 24 acres of prime farmland. About 102 acres of soils with poor potential for revegetation and 16 acres of prime farmland would remain impacted during the operational and maintenance phase of the project.

## 3.7.4 Cumulative Effects

The cumulative impacts of CBM development in the Project and surrounding areas are of concern. The cumulative effects analysis area includes the Project Area and the area where oil and gas development has and will continue to take place within the bounds of the Southern Ute Reservation. Cumulative soils impacts also result from other ground disturbing actions including the Missionary Ridge wildfire, timber harvest, OHV use, agriculture and rangeland activities, and aggregate (sand and gravel) mining. Reasonably foreseeable future activities, such as projected residential, commercial, and industrial development, identified in the 2001 La Plata County Impact Report (CIR) for oil and gas development, are also considered when evaluating cumulative soils impacts.

The quantitative analysis is limited to oil and gas development, which is quantified for the entire cumulative effects analysis area. The extent and timing of some effects, especially on private lands, are difficult to quantify because of a lack of data.

Cumulative soil erosion impacts in the bounds of the SUIT Reservation are similar to the effects described for this project. CBM and conventional gas facility construction and operation, especially on soils that have high potential for wind and water erosion, would trigger increased erosion and sedimentation in surface water as a result of vegetation clearing, heavy equipment traffic, wind, and precipitation. Oil and gas development within the bounds of the Southern Ute Reservation would result in a maximum of 447 new wells constructed in areas of highly erosive soils, impacting a maximum of 1,368 acres (1.6 percent of the

SUIT FEIS study area) in the short term and 921 acres (1.1 percent of the SUIT FEIS study area) in the long term. Existing and proposed CBM development in the Project Area under Alternative 1 would impact 153 acres on soils with high potential for wind or water erosion in the short term (less than 0.1 percent of the Project Area), and 97 acres (less than 0.1 percent of the Project Area) in the long term. Oil and gas development would cumulatively impact 1,521 acres during construction and 1,018 acres during operation and maintenance on highly erosive soils, which is approximately 0.2 percent of the cumulative effects analysis area) for both development phases.

Soil erosion impacts would be partially mitigated on both federal and Tribal jurisdictions by implementing mitigation measures that include graveling road surfaces to avoid dust and loss of soil to wind erosion; revegetating or covering any soil stockpiles that would remain for extended periods to avoid significant wind and water erosion; installing slope breaks and silt fences on slopes to slow and filter storm water runoff that might carry exposed soils to surface water drainages; timely reclamation of disturbed areas to minimize erosion after construction of facilities; and avoiding locations having highly erosive soils, where possible.

The Missionary Ridge fire north of the Project Area exposed highly erosive soils in areas where vegetative cover previously held the soil in place. Since the fire, significant erosion and debris flows have occurred within the burned area. Soils eroded from the burn area, although they originate outside the cumulative impacts analysis area, reach the lower gradient channels of the Florida, Animas, and Los Pinos Rivers, and short-term changes in water quality have been observed (FS 2003a). Furthermore, the flow of water over the burn area could carry sediment into the Project Area, which would contribute to any sedimentation caused by CBM development. Reclamation and treatment in the burn area, such as aerial seeding and log erosion barriers, have mitigated some of the erosion and will continue to do so in the future until vegetation becomes reestablished. The log erosion barriers installed near Lemon Reservoir have proved successful in slowing free flow of water and sediment downslope and fostering infiltration into the soil (FS 2002a).

The projected residential, commercial, and industrial growth anticipated within the cumulative effects analysis area would all contribute to localized erosion. The impact is considered minor, however, and is not quantifiable for this study.

Soil erosion in the cumulative effects analysis area realized under Alternative 2 would be greater than the impacts discussed for Alternative 1 because of the higher level of development in the Project Area. The increased surface disturbance would cause greater exposure of erosive soils to wind and water, resulting in higher levels of erosion. Alternatives 1A, 4, 3, 1B, and 5, in descending order of impact, would all result in less soil erosion than Alternatives 1 and 2.

Topsoil loss from existing and proposed CBM development in the SUIT FEIS study area is similar to the impact described for the Project Area. Areas of prime farmland would be affected by conversion of land from agricultural production to gas facilities. Prime farmland occurs in the northeastern quarter of the SUIT study area. Oil and gas development within the bounds of the reservation would result in a maximum of 30 new wells that could affect prime farmland, which would impact a maximum of 92 acres (0.44 percent of the prime farmland within the SUIT FEIS study area). Less than 1 percent of existing and proposed CBM wells in the Project Area are located on farmland used for crop production, all in a small area along the upper section of the Florida River in the Project Area and near Bayfield.

## 3.7.5 Mitigation and Monitoring

Minimizing disturbance and the use of BMPs are standard practices used to reduce or eliminate the potential for mass wasting, soil erosion, soil contamination topsoil loss, and loss of soil productivity. The measures that would be followed under the proposed action and alternatives are described fully in Appendix F. Unless otherwise stated, the measures will be funded by the Companies and include:

- Avoid development, where possible, in areas where soils with high shrink-swell capacity, potential for compaction, or high potential for collapsibility are present.
- Avoid development, where possible, in areas where soils with high potential for water and wind erosion are present.
- Limit CBM-related vehicular traffic to the traveled surface of access roads identified in the APD.
- Wet down and compact road surfaces with gravel cover where needed to avoid dust and loss of soil to wind erosion.
- Revegetate or cover any stockpiles that would remain for extended periods and avoid depositing excavated topsoil in drainageways.
- Maintain original flow patterns as much as possible.
- Stockpile topsoil and sub-surface soil in separate areas to avoid mixing.
- Install slope breaks and silt fences on slopes.
- Implement timely reclamation to minimize loss of soil caused by water erosion.
- Investigate slope stability and avoid high construction before siting new CBM facilities.
- Loosen and rip all compacted soils on the contour. A soil is considered compacted when there is a 15 percent increase in bulk density or a 59 percent decrease in macro pore space.
- Design all new roads constructed or existing roads reconstructed on NF and BLM lands under the direction of a registered professional engineer. Utilize a geotechnical engineer to address portions of the roads that cross steep slopes or that have characteristics for mass failure of the road, the side slopes, or both.
- Design road grades at a maximum of 8 percent, except for short pitches of 300 feet or less, unless previously approved by the FS.
- Provide drainage over the entire road. Drainage usually can be accomplished by the use of dips. Ditches and culverts may be necessary to facilitate winter access.
- Close new access roads on NF and BLM land year-round to the public.

- Restrict equipment to main service roads, during periods when soils are too wet. Soils are too wet when the soil moisture content exceeds the plastic limit. If soils within 4 inches of the surface can be rolled into threads that are 3 millimeters in diameter without breaking or crumbling, they are too wet.

Other BMPs and more site-specific mitigation measures related to soil impacts that affect surface water quality are described in Section 3.6, Surface Water Resources.

## 3.7.6 Conformance to Existing Plans and Policies

### 3.7.6.1 Conformance with FS Land Use Plans

The LRMP for the SJNF (FS 1983) establishes direction and standards, and guidelines for managing soil resources. The standards and guidelines specify ways that soils will be protected during conduct of activities on the SJNF. The standards and guidelines are followed during project planning and implementation and facility construction will adhere to the SJNF management requirements. With implementation of the mitigation measures outlined in this section and the surface water and vegetation sections during the design or siting and the operational and maintenance phases of the project, all alternatives would conform to the requirements of the LRMP for the SJNF.

### 3.7.6.2 Conformance with BLM Land Use Plans

The RMP for the San Juan/San Miguel Resource Areas (BLM 1985) established general objectives and guidelines for soil management to maintain productivity and minimize erosion. Soil resources are evaluated on a case-by-case basis at the project-level planning stage. Stipulations are attached as appropriate, and examples of BMPs are attached to the RMP as Appendix F.

The CBM development would conform to the RMP with the application mitigation measures specified in this and the surface water and vegetation sections during the design or siting and the operational and maintenance phases of the project.

## 3.7.7 Unavoidable Adverse Effects

Unavoidable adverse soils effects would occur under each of the alternatives. The extent of disturbance for Alternative 1 would be half the magnitude of Alternative 2, and greater than Alternatives 1A through 5. The extent of change in physical characteristics of the soil and in erosion, sedimentation, and topsoil productivity would be greatest under Alternative 2, followed by Alternative 1, Alternative 1A, Alternative 1B, Alternative 4, Alternative 3, and Alternative 5. Vegetative cover that provides soil stability would likely not be replaced on well pads and other CBM facilities for an extended period, causing adverse impacts to soil stability and productivity. Erosion and sedimentation would occur when well pads and other CBM facilities are clear of vegetation and not yet reclaimed or where reclamation has been unsuccessful. Soils that were productively cultivated before CBM development would remain out of productivity until the area is fully reclaimed. Soils impacted by CBM development that have the potential for agricultural use could not be developed until they are fully reclaimed.

## 3.7.8 Irreversible and Irretrievable Effects

An irreversible or irretrievable commitment of resources would occur when soils are consumed, committed, or lost as a result of the project. The commitment of soil resources would be irreversible if the project started a process that could not be stopped. As a result, the soil or its productivity or utility would be consumed, committed, or lost forever and could not be retrieved to the areas from which it originated. There would be an irreversible commitment of soil resources when erosion occurs from CBM-disturbed areas. The erosion process would continue for an extended period, until reclamation and revegetation are successful at the end of the project. The areas where reclamation and revegetation are not successful would experience the irreversible commitment of eroded soil resources beyond the life of the project.

Commitment of a resource would be considered irretrievable when the project directly eliminates the soil, its productivity, or its utility for the life of the project and beyond. Irretrievable effects to soils would occur with the removal of vegetative cover on CBM facility pads, which would expose soils to potential erosion that would occur for the life of the project until revegetation is successful. Any soil eroded during that time would be lost forever and the characteristics of the soil at the point of erosion would change, altering the soil's stability and productivity for the life of the project and potentially beyond. Prime farmland where CBM facilities are constructed would be removed from prior or potential agricultural use for the life of the project and likely beyond.

# 3.8 Vegetation, Riparian Areas/Wetlands, and Old-Growth Ponderosa Pine

## 3.8.1 Issues

*Issue 8: The effect of CBM development on vegetation, including wetlands, riparian areas, and old growth ponderosa pine forests*

- What are the recovery timeframes for vegetation disturbed by CBM development?
- How will habitat structural stages (by vegetation type) be affected by CBM development?
- Will further CBM development affect quantity and quality of the groundwater and surface water and, in turn, wetlands, and riparian areas?
- How will vegetation restoration proceed in areas disturbed by CBM development?
- How will noxious weeds be controlled?
- How will old growth ponderosa pine and other old growth forest types be affected by CBM development, and can these effects be avoided or mitigated?
- How will ecological processes associated with fire and insects and disease be affected by CBM development?

*Issue 16: The effects of CBM development on federal and state listed threatened, endangered, proposed, candidate, and sensitive plant species and their habitats*

## 3.8.2 Affected Environment

### 3.8.2.1 Regional Characterization

The Project Area is located along the eastern edge of the Colorado Plateau physiographic province, near the San Juan Mountains section of the Southern Rocky Mountains physiographic province (Mutel and Emerick 1992). The edge of the Colorado Plateau is distinguished by a series of mountain ranges and plateaus that are lower in elevation than the adjacent Rocky Mountains. Several rivers and smaller streams that descend from the Rocky Mountains have cut channels through these ranges.

The climate in this region is arid except at higher elevations. Here, additional winter snowfall and summer thunderstorms support denser vegetation.

A variety of soils occur in the Project Area. They have developed as a result of various interactions of environmental factors, including parent material, climate, living organisms, topography, and time. Any one of these five factors can vary widely over short distances, causing large differences in properties of the soil. This variation is especially pronounced in mountainous terrain, where soils have developed in response to physiographic differences in slope, aspect, and elevation. Consequently, properties of soil are highly variable in depth, texture, organic matter, permeability, available water capacity, and cation exchange capacity. The vegetation in the Project Area reflects this high range of variability in soil types.

## 3.8.2.2 Vegetation Types

There area nine vegetation types found in the Project Area: grasslands, sagebrush, pinyon-juniper, mountain shrub, Gambel oak, ponderosa pine, mixed conifer, aspen, and riparian. Many of these vegetation types occur in mosaics, depending on slope, aspect, soil type, and other physical parameters. Distinct boundaries are rarely found between these types. For example, areas dominated by Gambel oak make up the Gambel oak vegetation type. However, Gambel oak also occurs as a non-dominant component of the mountain shrub, pinyon-juniper, and ponderosa pine vegetation types. Three additional land cover types — agriculture, barren, and water — are also found in the Project Area.

Each of these vegetation and land cover types is described in the following sections and is shown on Figure 3–33. The extent of each vegetation and land cover type within the Project Area is presented in Table 3–46. Seral stages and old growth are discussed in Sections 3.8.2.4 and 3.8.2.8.

**Table 3–46 Distribution of Existing Vegetation Types in the Project Area**

| | Areal Extent | | | | | |
|---|---|---|---|---|---|---|
| Vegetation Type | NFS Land (acres) | BLM (acres) | State (acres) | Private (acres) | Total (acres) | Portion of the Project Area (percent) |
| Grasslands | 3,188 | 640 | 778 | 8,152 | 12,758 | 10.2 |
| Sagebrush | 1,353 | 1,168 | 382 | 9,108 | 12,012 | 9.6 |
| Pinyon-Juniper | 9,637 | 1,822 | 1,132 | 13,303 | 25,895 | 20.7 |
| Mountain Shrub | 437 | 289 | 290 | 1,650 | 2,666 | 2.1 |
| Gambel Oak | 9,698 | 653 | 691 | 7,877 | 18,919 | 15.1 |
| Ponderosa Pine | 19,388 | 1,700 | 1,041 | 12,564 | 34,693 | 27.7 |
| Mixed Conifer | 4,348 | 18 | 52 | 150 | 4,568 | 3.6 |
| Aspen | 1,249 | 4 | 4 | 55 | 1,313 | 1.0 |
| Riparian/Wetlands | 26 | 7 | 6 | 641 | 679 | 0.5 |
| Agriculture | 0 | 0 | 0 | 9,343 | 9,343 | 7.5 |
| Barren | 78 | 369 | 84 | 1,789 | 2,320 | 1.9 |
| Water | 2 | 0 | 1 | 180 | 183 | 0.1 |
| Total | 49,404 | 6,671 | 4,462 | 64,812 | 125,348 | 100.0 |

Source: FS and BLM 2003

### *3.8.2.2.1 Grasslands*

This vegetation type includes all dry and mesic areas that are dominated by herbaceous species outside of riparian areas and wetlands. Grasslands occur in scattered areas of fine-grained or deep soils with low to moderate slopes, primarily in the western two-thirds of the Project Area. Common species found in grasslands include blue grama (*Bouteloua gracilis*), squirrel-tail (*Elymus elymoides*), galleta (*Hilaria jamesii*), basin wild-rye (*Leymus cinereus*), salina wild-rye (*Leymus salinus*), Indian ricegrass (*Oryzopsis hymenoides*), western wheatgrass (*Pascopyrum smithii*), alkali sacaton (*Sporobolus airoides*), and needle-and-thread (*Stipa comata*). Various shrubs can also occur in grasslands, although at lower densities than in shrublands. Common shrub species include four-wing saltbush (*Atriplex canescens*), shadscale (*Atriplex confertifolia*), rabbitbrush (*Chrysothamnus nauseosus*), and snakeweed (*Gutierrezia sarothrae*).

Mountain meadows are also part of this vegetation type and occur as small, isolated patches in areas of low slope at higher elevations. Mountain meadows are found only in the eastern one-third of the Project Area and cover 6 acres. Soils typically are shallow to deep, fine-grained, and can be moist or dry, depending on local conditions. Common species found in the mountain meadow community include yarrow (*Achillea lanulosa*), fringed sage (*Artemisia frigida*), elk sedge (*Carex geyeri*), Arizona fescue (*Festuca arizonica*), scarlet gilia (*Ipomopsis aggregata*), prairie junegrass (*Koelaria macrantha*), mountain muhly (*Muhlenbergia montana*), and muttongrass (*Poa fendleriana*).

### 3.8.2.2.2 Sagebrush

Sagebrush shrublands are often associated with grasslands and pinyon-juniper woodlands, primarily in the western two-thirds of the Project Area and along the Piedra River valley on the eastern end of the Project Area. Soils in areas of sagebrush shrublands are typically deep and moderately fine-grained to sandy. Areas of finer soils often support a sagebrush-grass mix, whereas sagebrush intergrades with pinyon-juniper in areas of thinner, rockier soil. This vegetation type is dominated by basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) mixed with other shrub species, such as bitterbrush (*Purshia tridentata*), four-wing saltbush, rabbitbrush, and snakeweed. Grass species are more common in areas of sagebrush-grass mix, while the understory is often more sparse in areas of pure sagebrush. Other common plant species in sagebrush shrublands include blue grama, side-oats grama (*Bouteloua curtipendula*), squirrel-tail, galleta, basin wild-rye, Indian ricegrass, western wheatgrass, Sandberg bluegrass (*Poa secunda*), and sand dropseed (*Sporobolus cryptandrus*).

### 3.8.2.2.3 Pinyon-Juniper

Pinyon-juniper is the second most common vegetation type in the Project Area (Table 3–46), occurring throughout the area at middle elevations. Soils in areas of pinyon-juniper are typically shallow and vary from stony and coarse to clay. Utah juniper (*Juniperus osteosperma*) is slightly more tolerant of hot, dry conditions and is often found at the lower elevations of this vegetation type, while pinyon pine (*Pinus edulis*) becomes more dominant at the upper elevations. Several other vegetation types, including sagebrush, Gambel oak (*Quercus gambelii*), and mountain shrublands, may be adjacent to pinyon-juniper. Older and denser stands of pinyon-juniper often contain little understory, while younger stands often support a mix of trees, shrubs, and grasses. Common species within this vegetation type include juniper, pinyon pine, basin big sagebrush, bitterbrush, serviceberry (*Amelanchier utahensis*), mountain mahogany (*Cercocarpus montanus*), blue grama, side-oats grama, galleta, Indian ricegrass, western wheatgrass, muttongrass, and needle-and-thread.

### 3.8.2.2.4 Mountain Shrub

The mountain shrub vegetation type is relatively limited in extent in the Project Area; however, the shrub species that define this type often occur in other vegetation types but are not dominant. This vegetation is often adjacent to the pinyon-juniper and Gambel oak types. Pure stands of mountain shrub are most common on steeper, south-facing slopes of hogbacks in the northwest part of the Project Area. Mountain shrublands occur in a variety of sites, ranging from shallow, rocky soils dominated by mountain mahogany, to deeper, moister soils dominated by Gambel oak. Common species in this vegetation type include mountain mahogany, serviceberry, basin big sagebrush, bitterbrush, Gambel oak, skunkbush sumac (*Rhus trilobata*), snowberry (*Symphoricarpos rotundifolius*), chokecherry (*Prunus virginiana*), blue grama, elk sedge, galleta, junegrass, western wheatgrass, muttongrass, Sandberg bluegrass, and needle-and-thread.

### 3.8.2.2.5 Gambel Oak

After ponderosa pine and pinyon-juniper, Gambel oak is the third most common vegetation type in the Project Area (Table 3–46). This type is particularly well developed on slopes on the eastern third of the Project Area, although it occurs elsewhere in smaller stands within pinyon-juniper woodlands, mountain shrublands, and ponderosa pine (*Pinus ponderosa*) forest. Gambel oak tends to mix with ponderosa pine at upper elevations. Gambel oak can be a substantial, but non-dominant, component of both the pinyon-juniper and ponderosa pine vegetation types. It also occurs to varying degrees in the mountain shrub vegetation type. The understory of dense stands of Gambel oak is often sparse because of the shading effect of the trees, although more open stands support a variety of shrubs, grasses, and forbs. Common species in the Gambel oak vegetation type include Gambel oak, serviceberry, mountain mahogany, chokecherry, skunkbush sumac, Wood's rose (*Rosa woodsii*), snowberry, elk sedge, slender wheatgrass (*Elymus trachycaulus*), prairie junegrass, and mountain muhly.

### 3.8.2.2.6 Ponderosa Pine

Ponderosa pine is the most common vegetation type in the Project Area (Table 3–46). It occurs at middle elevations in relatively large stands that mix extensively with the Gambel oak vegetation type. It is most common on the northern half of the western two-thirds of the Project Area (Figure 3–33). It is also commonly found in the eastern third of the Project Area, where it mixes with Douglas-fir (*Pseudotsuga menziesii*) and aspen (*Populus tremuloides*) at higher elevations, on north slopes, and in areas with moister and deeper soils. Depending on the fertility of soil and the availability of moisture, ponderosa pine can form open, savanna-like stands with an abundant herbaceous understory or more dense, forest-like stands. Fire exclusion over the last century has allowed pine stands to develop with unnaturally large numbers of sapling to pole-sized trees. Ponderosa pine is the dominant species in this vegetation type, although Gambel oak often forms a substantial part of many stands. In addition, Rocky Mountain juniper often occurs mixed with pine. The understory may be composed of a diverse species mix, including kinnikinnick (*Arctostaphylos uva-ursi*), mountain mahogany, common juniper (*Juniperus communis*), Oregon grape (*Mahonia re-*

*pens*), bitterbrush, buckbrush (*Ceanothus fendleri*), pine dropseed (*Blepharoneuron tricholepis*), elk sedge, junegrass, and mountain muhly. The old-growth forests that occur within this type are described in Section 3.8.2.8.

#### 3.8.2.2.7 Mixed Conifer

This vegetation type is diverse and may contain the following species: Douglas-fir, white fir (*Abies concolor*), ponderosa pine, Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), and aspen. Mixed conifer occurs at higher elevations in the eastern third of the Project Area, typically on north-facing slopes. The overstory in these stands is often dense. At the low edge in elevation for mixed conifer, ponderosa pine often mixes with Douglas-fir. There are isolated patches of Engelmann spruce and subalpine fir in higher mountain ranges in the Project Area. Common plant species in the mixed conifer vegetation type include white fir, subalpine fir, common juniper, Oregon grape, Engelmann spruce, Douglas-fir, wax current, Wood's rose, heart-leaf arnica (*Arnica cordifolia*), nodding brome (*Bromus porteri*), elk sedge, Arizona fescue, junegrass, and mountain muhly.

#### 3.8.2.2.8 Aspen

The aspen vegetation type occurs as small, isolated patches at higher elevations, primarily in the eastern third of the Project Area (Figure 3–33). Aspen also occurs as a component of the ponderosa pine and mixed conifer vegetation types. Aspen stands typically develop on moist, deep soils, are early seral in nature, and are eventually replaced by conifer species in the absence of disturbance. Common species in the aspen vegetation type include Saskatoon serviceberry (*Amelanchier alnifolia*), common juniper, Oregon grape, chokecherry, common gooseberry, Wood's rose, snowberry, heart-leaf arnica, nodding brome, elk sedge, blue wild-rye (*Elymus glaucus*), slender wheatgrass, Thurber's fescue (*Festuca thurberi*), Richardson's geranium (*Geranium richardsonii*), and Fendler's meadow-rue (*Thalictrum fendleri*).

#### 3.8.2.2.9 Riparian/Wetlands

The riparian/wetlands type typically occurs as narrow bands of vegetation adapted to growing in frequently wet or saturated conditions. Riparian areas "develop in transitional zones between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence" (Leonard et al. 1992). The characteristics of distinct vegetation and soil contribute to high species diversity and productivity. Continuous interactions occur among riparian, aquatic, and upland terrestrial communities through the exchange of energy and nutrients. The vegetation that visually defines a riparian area is valuable in retaining sediment, attenuating flood flows, stabilizing stream banks, removing and transforming nutrients, increasing forage production for livestock and wildlife (relative to uplands), and promoting habitat diversity for terrestrial wildlife.

Riparian areas occasionally form along intermittent streams and unlined or leaky irrigation ditches, although in these cases they rarely provide the functions and values of natural riparian ecosystems. Vegetation in riparian areas often consists of a mosaic of herbaceous wet meadows with an overstory of shrubs or trees, depending on the frequency and intensity of disturbances, such as large flood

events. Common riparian species include boxelder (*Acer negundo*), alder (*Alnus incana* ssp. *tenuifolia*), narrow-leaf cottonwood (*Populus angustifolia*), Fremont cottonwood (*Populus deltoides*), quaking aspen, sandbar willow (*Salix exigua*), wax current, common spike-rush (*Eleocharis palustris*), foxtail barley (*Hordeum jubatum*), and arctic rush (*Juncus arcticus*).

Wetlands are also included in this vegetation type. Wetlands are landscape features that are delineated based on specific soil, vegetation, and hydrologic conditions. A wetland is defined as "an area typically flooded or saturated with sufficient frequency and/or duration, with surface water or groundwater, that these areas support mostly vegetation adapted for growth in soils that are saturated under normal circumstances" (40 CFR 230). Although riparian areas often contain wetlands, they may also contain areas that do not meet the definition of wetlands. Likewise, not all wetland areas are associated with riparian communities.

Wetlands occur in a variety of forms within the Project Area. Riverine wetlands, defined by their close association with perennial streams, occur along stream channels and are often associated with riparian areas. These areas are also supported by groundwater drainage associated with floodplains and by periodic flooding events. Riverine wetlands are divided into categories based on the nature of the adjacent stream (for example, upper perennial or intermittent). Riverine wetlands can be further divided based on the dominant plant life form or the physiography and composition of the substrate (for example, unconsolidated bottom, unconsolidated shore, or streambed) and the seasonal water regime (for example, permanently flooded, semipermanently flooded, seasonally flooded, or temporarily flooded) (Cowardin et al. 1979).

Topographical depressions or other areas that are naturally sub-irrigated support palustrine wetlands, which are commonly referred to as wet meadows, and are occupied by a variety of lush plant life. These wetlands are often associated with riparian meadows and occur directly upslope from riverine wetlands. Palustrine wetlands can be further divided based on the dominant plant life form or the physiography and composition of the substrate (for example, aquatic bed, emergent, forested, scrub-shrub, unconsolidated bottom, or unconsolidated shore) and the seasonal water regime (for example, intermittently exposed, semipermanently flooded, seasonally flooded, saturated, or temporarily flooded) (Cowardin et al. 1979). Typical plant species that occur in wetlands include the same set found in riparian areas, with the addition of more typical wetland species, such as water sedge (*Carex aquatilis*), woolly sedge (*Carex lanuginosa*), hard-stem bulrush (*Scirpus acutus*), three-square bulrush (*Scirpus pungens*), and broad-leaf cattail (*Typha latifolia*).

### *3.8.2.2.10 Agriculture*

Agricultural lands are most common in the western two-thirds of the Project Area (Figure 3–33). This land cover type includes irrigated and non-irrigated croplands, pasturelands, hay fields, and orchards. Agricultural fields have been cleared from areas that were formerly occupied by grasslands, sagebrush shrublands, and pinyon-juniper woodlands, generally where relatively deep soils have developed on low slopes. The floodplains of the Florida and Pine Rivers are also used for agriculture. Alfalfa and various grasses are the crops most commonly grown and are used for both pasture and hay. Other crops grown in the Project

Area include grains, corn, and beans. In addition to planted crops, various weedy species, including noxious weeds, are often present in agricultural areas.

#### 3.8.2.2.11 Barren

Barren areas are made up of a diverse group of non-vegetated areas, including urban lands, exposed rock, talus slopes, roads, oil and gas facilities, and other areas that lack vegetation cover. Any vegetation that occurs in these areas is sparse and often weedy. Noxious weeds are often present when disturbance is human-caused, such as around residential or industrial areas and along roads.

#### 3.8.2.2.12 Water

Large areas of open water are rare in the Project Area, but a few small lakes and ponds account for this land cover type. These areas are often surrounded by wetlands or riparian vegetation.

### 3.8.2.3 Vegetation Disturbance and CBM Development

#### 3.8.2.3.1 Concerns

Vegetation is removed during construction of roads, well pads, and other supporting facilities. Desirable native species and vegetation types may be disturbed or removed, reducing vegetative productivity and the value of the vegetation for other resource uses, such as livestock grazing or wildlife habitat.

#### 3.8.2.3.2 Effects of CBM to Date

Vegetation types have been altered by past CBM development in the Project Area. In some cases, vegetation has been entirely removed; in other cases, it has been degraded through loss of some species or introduction of noxious weeds. The extent of existing impacts attributable to past CBM development is shown in Table 3–47. In addition to CBM development, agricultural, residential, and other land uses have altered native vegetation. Native vegetation has been removed by conversion to other land uses or has been degraded by loss of species and introduction of non-native species, including noxious weeds. Some of these alterations are reflected in the current amount of area in the vegetation types in Section 3.8.2.2 and Table 3–46, particularly in the agriculture and barren land cover types. Many of the impacts identified in the barren type are likely the result of past impacts to other vegetation types that were barren when the vegetation was classified.

Vegetation impacts have been concentrated in the lower elevations and on private lands where the predominant vegetation is sagebrush shrublands and grasslands, as reflected in Table 3–47. The public lands, on the other hand, have seen less development. This lesser amount of development is reflected in vegetation types that are dominant on these lands, such as mixed conifer and aspen.

**Table 3–47 Existing CBM Impacts to Vegetation in the Project Area**

| | Areal Extent | | | | | |
|---|---|---|---|---|---|---|
| Vegetation Type | NFS land (acres) | BLM (acres) | State (acres) | Private (acres) | Total (acres) | Portion of Vegetation Type (percent) |
| Grasslands | 41 | 8 | 17 | 220 | 286 | 2.2 |
| Sagebrush | 26 | 12 | 7 | 175 | 221 | 1.8 |
| Pinyon-Juniper | 53 | 6 | 10 | 161 | 229 | 0.9 |
| Mountain Shrub | 8 | 1 | 2 | 10 | 21 | 0.8 |
| Gambel Oak | 72 | 1 | 4 | 85 | 162 | 0.9 |
| Ponderosa Pine | 197 | 5 | 8 | 100 | 310 | 0.9 |
| Mixed Conifer | 9 | 0 | 0 | 0 | 9 | 0.2 |
| Aspen | 7 | 0 | 0 | 0 | 8 | 0.6 |
| Riparian/Wetlands | 1 | 0 | 0 | 10 | 11 | 1.7 |
| Agriculture | 0 | 0 | 0 | 113 | 113 | 1.2 |
| Barren | 3 | 5 | 5 | 104 | 117 | 5.1 |
| Water | 0 | 0 | 0 | 1 | 1 | 0.5 |
| Total | 418 | 38 | 53 | 980 | 1,489 | 1.2 |

## 3.8.2.4 Habitat Structural Stages and CBM Development

### 3.8.2.4.1 Baseline

The vegetation types in the Project Area provide a wide range of habitats for many wildlife species. Key habitat types in the Project Area include grasslands, sagebrush shrublands, pinyon-juniper woodlands, Gambel oak woodlands, ponderosa pine forests, and mixed conifer forests. Habitat structural stages (HSSs) are based on the classification of both size and density of vegetation present. They are expressed as a combination of number and letter. The number represents vegetation (size 1 is grass/forb, 2 is shrub/seedling, 3 is sapling/pole, 4 is mature/overmature, and 5 is old growth), and the letter represents density (A is less than 40 percent crown cover, B is 40 to 70 percent crown cover, and C is greater than 70 percent crown cover). Non-timber HSSs in the Project Area include 1M (natural meadow), 1T (areas that are potentially timbered but currently in an early seral structural stage dominated by grasses, for example, recent timber harvest units), 2S (natural shrubland), and 2T (areas that are potentially timbered but currently in an early seral structural stage dominated by shrubs, for example, old burned areas). Timbered HSSs include 3A, 3B, 3C, 4A, 4B, 4C, and 5, representing the diversity of types of timber stands present. Table 3–48 presents the extent of each HSS for each vegetation type that is present on NFS lands in the Project Area.

**Table 3–48 Distribution of Habitat Structural Stages on NFS Lands in the Project Area**

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 2,285 | 903 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,188 |
| Sagebrush | 0 | 0 | 0 | 1,353 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,353 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 2,161 | 4,485 | 0 | 1,741 | 1,249 | 0 | 0 | 9,637 |
| Mountain Shrub | 0 | 0 | 0 | 437 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 437 |
| Gambel Oak | 0 | 0 | 0 | 9,444 | 254 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,698 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 255 | 538 | 31 | 9,431 | 8,331 | 55 | 746 | 19,388 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 18 | 857 | 108 | 364 | 2,539 | 463 | 0 | 4,348 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 276 | 405 | 19 | 102 | 426 | 21 | 0 | 1,249 |
| Riparian | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 23 | 0 | 0 | 0 | 26 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barren | 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 78 |
| Water | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Total | 80 | 2,285 | 903 | 11,237 | 254 | 2,711 | 6,285 | 158 | 11,661 | 12,545 | 540 | 746 | 49,404 |

The HSSs delineations on NFS land are based on data in the Common Vegetation Unit (CVU) database maintained by the SJNF (FS and BLM 2003). The CVU data were combined with data from an old growth inventory (as discussed in more detail in Section 3.8.2.8) to create the dataset used for this analysis. HSSs for BLM, state, and private lands were derived from the vegetation type data presented in Section 3.8.2.2. The proportional distribution of HSSs on BLM, state, and private lands was assumed to be the same as on NFS lands. These proportions were applied to each vegetation type to create Table 3–49, which shows the distribution of HSSs throughout the Project Area, including NFS, BLM, state, and private lands.

**Table 3–49 Distribution of Habitat Structural Stages in the Project Area**

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 9,145 | 3,613 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,758 |
| Sagebrush | 0 | 0 | 0 | 12,012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,012 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 5,807 | 12,052 | 0 | 4,679 | 3,357 | 0 | 0 | 25,895 |
| Mountain Shrub | 0 | 0 | 0 | 2,666 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,666 |
| Gambel Oak | 0 | 0 | 0 | 18,424 | 495 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18,919 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 457 | 963 | 56 | 16,876 | 14,908 | 99 | 1,335 | 34,693 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 19 | 900 | 113 | 382 | 2,667 | 487 | 0 | 4,568 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 290 | 425 | 20 | 107 | 448 | 22 | 0 | 1,313 |
| Riparian | 0 | 0 | 0 | 74 | 0 | 0 | 0 | 0 | 605 | 0 | 0 | 0 | 679 |
| Agriculture | 9,343 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,343 |
| Barren | 2,320 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,320 |
| Water | 183 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 183 |
| Total | 11,846 | 9,145 | 3,613 | 33,175 | 495 | 6,573 | 14,340 | 190 | 22,650 | 21,378 | 608 | 1,335 | 125,348 |

CBM development directly removes vegetation and may cause loss of HSSs that are important to wildlife. A decrease in the availability of certain HSSs may detrimentally affect wildlife species that preferentially use these stages. Wildlife species that may be affected include MIS, federally listed threatened, endangered, and candidate species, FS and BLM sensitive species, Colorado state-listed threatened, endangered, and special concern species, and other wildlife species. The SJNF utilizes specific guidelines to maintain landscape diversity, including guidelines that at least 5 percent of an area be in an old-growth structural stage (HSS 5) and 5 percent in the grass/forb structural stage (HSS 1). There are no corresponding diversity guidelines on BLM, state, or private lands.

#### *3.8.2.4.2 Effects of CBM to Date*

Table 3–50displays the impacts of existing CBM development on HSSs on NFS lands. Table 3–51 shows the impacts of existing CBM development on HSSs throughout the Project Area, including NFS, BLM, state, and private lands. No substantial shifts have occurred in the representation of HSSs because relatively small amounts of each HSS have been affected by existing CBM development.

**Table 3–50 Existing CBM Impacts to Habitat Structural Stages on NFS Lands in the Project Area**

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 37 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 41 |
| Sagebrush | 0 | 0 | 0 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 12 | 23 | 0 | 10 | 7 | 0 | 0 | 53 |
| Mountain Shrub | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| Gambel Oak | 0 | 0 | 0 | 68 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 72 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 0 | 85 | 99 | 0 | 10 | 197 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 6 | 0 | 0 | 9 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 0 | 0 | 1 | 0 | 0 | 7 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barren | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 3 | 37 | 5 | 102 | 5 | 15 | 32 | 0 | 98 | 114 | 0 | 10 | 418 |

## 3.8.2.5 Wetlands, Riparian Areas, and CBM Development

#### *3.8.2.5.1 Baseline*

Riparian areas within the Project Area are generally limited to the immediate vicinity of the larger rivers, such as the Animas, Florida, Pine, and Piedra Rivers, as well as a few of the larger streams such as Beaver Creek and Sauls Creek. The National Wetlands Inventory (NWI) has mapped wetlands in the Project Area (Figure 3–34). Small, scattered wetlands may be located throughout the Project Area that do not appear on NWI maps, and wetlands shown on NWI maps have not been verified in the field. For these reasons, NWI maps provide only an estimate of the extent and location of wetlands and cannot be used as a substitute for field-based delineations. As with riparian areas, wetlands are concentrated near the larger rivers and some perennial streams. Other wetlands are found scattered throughout the Project Area.

**Table 3–51 Existing CBM Impacts to Habitat Structural Stages in the Project Area**

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 212 | 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 286 |
| Sagebrush | 0 | 0 | 0 | 221 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 221 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 52 | 105 | 0 | 42 | 30 | 0 | 0 | 229 |
| Mountain Shrub | 0 | 0 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 |
| Gambel Oak | 0 | 0 | 0 | 155 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 162 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 2 | 6 | 0 | 140 | 147 | 0 | 14 | 310 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 6 | 0 | 0 | 9 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 0 | 0 | 2 | 0 | 0 | 8 |
| Riparian | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 11 |
| Agriculture | 113 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 113 |
| Barren | 117 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 117 |
| Water | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total | 232 | 212 | 74 | 398 | 7 | 56 | 117 | 0 | 194 | 185 | 0 | 14 | 1,489 |

There are 44 point wetlands, 210 miles of linear wetlands, and 935 acres of polygonal wetlands in the Project Area. The highest percentage of point wetlands is on private land (approximately 66 percent), while smaller percentages are on NFS (30 percent) and state (4 percent) lands. There are no point wetlands on BLM lands. The highest percentage of linear wetlands is on private land (approximately 81 percent), while smaller percentages exist on NFS (13 percent), state (5 percent), and BLM (1 percent) lands. The highest percentage of polygonal wetlands is found on private land (approximately 92 percent), while smaller percentages exist on NFS (5 percent), state (2 percent), and BLM (1 percent) lands.

According to NWI maps, 36 wetland types exist within the Project Area. The two most common point wetland types are palustrine, aquatic bed, semipermanently flooded (22 wetlands); and palustrine, unconsolidated shore, seasonally flooded (16 wetlands). Both of these wetland types represent stock ponds or other small impoundments. The most common linear wetland type in the Project Area is riverine, intermittent, streambed, seasonally flooded (90 miles), representing the abundance of streams that flow seasonally and support wetland vegetation along their banks. The second most common linear wetland type is palustrine, emergent, seasonally flooded (59 miles), which represents narrow strips of palustrine wetlands adjacent to riparian areas or riverine wetlands.

The most abundant polygonal wetland type is palustrine, emergent, seasonally flooded (299 acres). This and the fourth most abundant polygonal wetland — palustrine, emergent, saturated (104 acres) — represent large areas of wet meadow located in the floodplains of major streams. The second most common polygonal wetland — palustrine, aquatic bed, semipermanently flooded (165 acres) — represents areas of shallow water in lakes and reservoirs and along riparian areas that hold water for much of the year. The third most common polygonal wetland — riverine, upper perennial, unconsolidated bottom, permanently flooded (144 acres) — represents the larger perennial streams, including the Animas, Florida, Pine, and Piedra Rivers, that support wetlands along their banks.

#### 3.8.2.5.2 Concerns

CBM development may impact wetlands and riparian areas. Existing regulations, such as Section 404 of the Clean Water Act (CWA), control the types and amounts of impacts that can occur in wetlands and riparian areas. Well pads and compressor station construction is prohibited in wetlands and riparian areas. Access roads and pipelines are constructed across wetlands and riparian areas if other routes are not available. Sediment originating from well pads, roads, pipelines, and compressor stations located in uplands can move down into wetlands and riparian areas.

Furthermore, wetlands and riparian areas may be affected by activities that impact the amount of surface water and groundwater. Dewatering of the coal bed formations can reduce surface water flow in streams, springs, and seeps. The hydraulic relationship between streams and the Fruitland Formation aquifer may be reversed by intercepting groundwater that would normally discharge to streams. The amount of water produced could exceed the recharge rate and may cause surface water to drain into the Fruitland Formation (Cox et al. 2001). Wetlands, seeps, and springs that occur on or near the outcrop of the Fruitland Formation have the greatest risk of sustaining direct impacts because of CBM-related groundwater depletions and subsequent depletions of surface water.

#### 3.8.2.5.3 Effects of CBM to Date

Specific CBM development impacts to wetlands and riparian vegetation have not been identified. Existing development, particularly on state and private lands in the western two-thirds of the Project Area, has probably resulted in minor impacts to wetlands and riparian areas; however, the extent of these impacts has not been documented. Groundwater depletions and reduced groundwater discharges to surface drainages that has resulted from dewatering of the Fruitland Formation have affected the quantity of surface flows. To date, approximately 65 acre-feet/year are depleted from surface flows because of reduced groundwater discharge (Cox et al. 2001). Surface flows depletion have the potential to affect wetland and riparian areas by reducing the amount of water available to support vegetation; however, the reduction is negligible in relation to the amount of surface water flows, and no impacts have been documented to date.

### 3.8.2.6 Vegetation Restoration and CBM Development

#### 3.8.2.6.1 Concerns

Vegetation restoration is an important component of CBM development. Interim restoration of the portion of the impacted area that is not needed for production takes place after construction is complete. Once a well is abandoned, the entire impacted area is restored. Restored areas often differ from undisturbed areas in terms of the plant species present and the ecological function of the restored community. Restored areas where species composition and cover are altered may not serve ecosystem functions currently served by undisturbed vegetative communities. Vegetation communities slowly return to pre-construction conditions, particularly where shrubs or trees dominate the pre-disturbance community. The introduction of noxious weeds (as discussed in Section 3.8.2.7) can slow restoration because weeds compete with desirable species for water and nutrients. Harsh environmental conditions, such as drought and poor soils, may also make restoration difficult to achieve (Bell 2002b).

#### *3.8.2.6.2 Effects of CBM to Date*

Limited information is available on vegetation restoration success at existing CBM wells in the Project Area. Interim reclamation has generally been successful for the few producing wells where restoration has been monitored on NFS lands. During interim reclamation, the part of the well site to remain in use is covered with gravel to prevent erosion, and the remaining area is restored. Of two plugged and abandoned wells that have been monitored, final restoration has been successful at one site, but additional work is needed at the other to ensure success (Bell 2002b).

Areas impacted by road construction adjacent to the road surface are also subject to interim reclamation. Interim reclamation along roads has generally been successful. However, noxious weeds have been introduced in some locations, as discussed in Section 3.8.2.7. Noxious weeds are controlled through a cooperative agreement between the BLM/FS and CBM development companies. Control has generally been successful and, as a result, noxious weeds have not been a substantial problem in restoration. Instead, most cases of unsuccessful restoration are the result of harsh environmental conditions such as limited availability of water, low soil fertility, or a south-facing aspect (Bell 2002b).

### 3.8.2.7 Noxious Weeds and CBM Development

#### *3.8.2.7.1 Baseline*

A noxious weed is defined by the Colorado Weed Management Act as “an alien plant or parts of an alien plant that have been designated by rule as being noxious or has been declared a noxious weed by a local advisory board, and meets one or more of the following criteria: a) aggressively invades or is detrimental to economic crops or native plant communities; b) is poisonous to livestock; c) is a carrier of detrimental insects, diseases, or parasites; or d) the direct or indirect effect of the presence of this plant is detrimental to the environmentally sound management of natural or agricultural ecosystems” (CRS 2000). Appendix G lists noxious weeds of concern for the State of Colorado, Archuleta County, and La Plata County.

Noxious weeds occur throughout the Project Area (Cook 2002a, Ratliff 2002). La Plata County weed maps indicate the presence of the following noxious weeds within the La Plata County portion of the Project Area: musk thistle (*Carduus nutans*), spotted knapweed (*Centaurea maculosa*), yellow toadflax (*Linaria vulgaris,*), Canada thistle (*Cirsium arvense*), Russian knapweed (*Centaurea repens*), and Scotch thistle (*Onopordum acanthium*) (O’Donnell 2002). Leafy spurge (*Euphorbia esula*), musk thistle, and Russian knapweed are present in the portion of the Project Area in Archuleta County (Ratliff 2002). Table 3–52 lists the distribution and extent of known noxious weed infestations in the Project Area.

Throughout the western portion of the Project Area, infestations of noxious weeds are scattered throughout private lands. Infestations on NFS lands are located primarily along existing roads at lower elevations at the base of the HD Mountains. Figure 3–35 shows the location and extent of various noxious weed infestations in the Project Area.

### 3.8.2.7.2 Concerns

Non-native plant species have become increasingly common in the Project Area. Many of these species are opportunistic and are capable of invading the recently disturbed soil. Roads often serve as dispersal corridors between patches of disturbed ground, facilitating the spread of these species into new areas. Once they become established, non-native species can out-compete and eventually replace native species, thereby reducing forage productivity and the overall vigor of native plant communities. Because of these effects, many of these weed species are viewed as detrimental to the environment. Their occurrence, distribution, and density are variable and influenced by many factors, including disturbance type and frequency, climatic and soil conditions, and local management efforts.

**Table 3–52 Areal Extent of Known Noxious Weed Infestations in the Project Area**

| | Areal Extent (Acres) | | | | |
|---|---|---|---|---|---|
| Dominant/Co-dominant Species | NFS | BLM | State | Private | Total |
| Canada Thistle | 126 | 5 | 0 | 362 | 493 |
| Canada Thistle/Houndstongue | 0 | 0 | 0 | 0 | 0 |
| Canada Thistle/Musk Thistle | 1,061 | 0 | 1 | 57 | 1,119 |
| Canada Thistle/Musk Thistle/Common Mullein | 22 | 0 | 0 | 10 | 32 |
| Canada Thistle/Musk Thistle/Field Bindweed | 1 | 0 | 0 | 0 | 1 |
| Canada Thistle/Musk Thistle/Houndstongue | 95 | 0 | 0 | 53 | 149 |
| Canada Thistle/Spotted Knapweed | 0 | 0 | 0 | 18 | 18 |
| Houndstongue/Musk Thistle | 0 | 0 | 0 | 0 | 0 |
| Musk Thistle | 29 | 0 | 0 | 472 | 500 |
| Musk Thistle/Canada Thistle | 0 | 0 | 0 | 122 | 122 |
| Musk Thistle/Houndstongue | 0 | 0 | 0 | 0 | 0 |
| Musk Thistle/Russian Knapweed | 0 | 0 | 0 | 0 | 0 |
| Oxeye Daisy | 0 | 0 | 0 | 1 | 1 |
| Russian Knapweed | 0 | 0 | 0 | 37 | 37 |
| Scotch Thistle | 0 | 0 | 0 | 54 | 54 |
| Spotted Knapweed | 0 | 0 | 0 | 5 | 5 |
| Spotted Knapweed/Musk Thistle | 0 | 0 | 0 | 5 | 5 |
| Whitetop | 0 | 0 | 0 | 0 | 0 |
| Yellow Toadflax | 0 | 40 | 0 | 5 | 45 |
| Total | 1,334 | 45 | 1 | 1,201 | 2,581 |

CBM development results in surface disturbance that creates an opportunity for noxious weeds and other non-native species to establish. Vehicle and heavy equipment movement from site to site during CBM development can spread weed seeds into areas that are not currently infested. Once they are established, noxious weeds are extremely difficult to eradicate and can spread into undisturbed areas.

Interim reclamation after construction and final restoration at abandonment may also contribute to non-native and noxious weed species infestation. In addition, weed seeds are sometimes unintentionally included in seed mixes for revegetation, or are brought in on vehicles. Reclamation measure, such as removal of structures, recontouring, and discing of abandoned roads, may also provide opportunity for weeds to establish. Site revegetation immediately after surface disturbance is one method for minimizing the invasion of non-native and noxious weed species by providing competition from native species. Erosion control matting or other mulching materials may also help prevent weed invasion.

#### *3.8.2.7.3 Effects of CBM to Date*

The Project Area is near the urban centers of La Plata County and consequently receives a high level of use that contributes to the spread of noxious weeds. Recreation, timber sales, livestock grazing, gas development, and wildlife have all contributed to the presence of noxious weeds within the Project Area. Most noxious weeds within the Project Area are non-native colonizers that readily establish in areas of disturbed ground. Inventory, monitoring, and control efforts are ongoing on NFS lands in the Project Area. Approximately 27 miles of roadside and 60 acres of weed infestations are currently monitored and treated annually on NFS lands in the Project Area (Wood 2003).

Measures CBM companies take to prevent the spread of weeds on private lands during construction and maintenance of CBM-related facilities do not appear to be adequate. Once weed infestations are established, the companies spray for control (Cook 2002b). Noxious weeds found on private land subject to CBM development are identified and treated by the county where they are located. Noxious weeds in the Project Area are found along roadsides, including CBM access roads, indicating that vehicles are one of the potential vectors for spread of these species. New CBM roads are likely to serve as a conduit for weed invasion (Cook 2002b).

### 3.8.2.8 Old-Growth Ponderosa Pine and CBM Development

#### *3.8.2.8.1 Baseline*

The old-growth assessment on NFS lands relies on data collected using three different methods: field surveys, timber inventory data, and photo interpretation (FS and BLM 2003). The most reliable method is the actual field visit, where attributes of old growth are measured and recorded, and an old-growth score is calculated. More than 42,000 acres of ponderosa pine, 39,000 acres of mixed conifer, and 68,000 acres of spruce/fir have been inventoried across the SJNF using this method. Stand attributes collected in the field include tree age, tree diameter, number of snags, dead-topped or broken trees, rotten trees, canopy layers, and large trees per acre. An old-growth score is calculated from these attributes.

The second most reliable method for inventorying old growth is to use existing timber inventory data from the stand exam. A computer program extracts the attributes listed above from stand exam data and calculates an old-growth score. Approximately one-third of the SJNF has been inventoried for old growth using this method.

Stands that have not been inventoried by a field survey or by using stand exam data have been assigned old-growth scores using photo interpretation. These stands were assigned an old-growth score based on photo comparisons with sites that were similar in all aspects, such as slope, aspect, crown sizes and densities, and elevation; and that had been assigned a stand exam score. The stand exam score was applied to its photo-interpreted "look-alike" site. All photo-interpreted sites in the Project Area with a high score for old growth have been field-verified.

This analysis used the following definition to identify old-growth sites across the SJNF:

(1) Average age of upper canopy trees 200 years or greater;
(2) Average diameter of upper canopy trees 16 inches or greater;
(3) Ten or more trees per acre that are at least 16 inches diameter at breast height (DBH) or greater; and
(4) One or more rotten trees, or one or more "dead or broken top" trees per acre.

Snags are also considered an important component of old growth. They are not included in the specific query for the old-growth definition, however, because of known data gaps on snag density in the stand exam data. Instead, the snag density average has been calculated from all field-visited sites with tree ages more than 200 years old. The average snag density for these ponderosa pine sites forest-wide is 3.6 per acre. The average snag density for ponderosa pine sites more than 200 years old in the analysis area is 2.2 per acre.

A total of 746 acres of old-growth ponderosa pine stands have been recorded on NFS lands in the Project Area (Figure 3–36). These stands represent 3.8 percent of the total area of ponderosa pine on NFS lands in the Project Area (19,388 acres) and are located primarily in the southeastern portion of the Project Area, in the Spring Creek, Ignacio Creek, and other nearby watersheds. Forest-wide, there are 260,941 acres of ponderosa pine, of which 15,245 acres (5.8 percent) are old growth. Similar data have not been collected for BLM, state, or private lands in the Project Area, though the acreage of old growth pine is suspected to be lower on these other jurisdictions.

### 3.8.2.8.2 Concerns

Stands of old-growth ponderosa pine are an important biological resource for several reasons. First, the structure of these stands is typically more diverse, both horizontally and vertically. Trees of various ages and densities occur throughout the stand. Second, the understory is also typically more diverse than that of younger, more homogenous stands. Third, old-growth trees and stands contain tremendous genetic diversity, having survived and adapted to, and through, many droughts and other small climatic changes. Finally, old-growth stands provide important habitat for a number of wildlife species, including Forest Service sensitive and management indicator species (MIS), such as the northern goshawk, woodpeckers, and migratory songbirds. Old-growth forests also provide habitat to a variety of species with small home ranges or poor dispersal capacity, including lichens (Enns 1998).

Old-growth ponderosa pine is relatively uncommon across the Project Area and the SJNF. This lack of landscape abundance is primarily the result of timber harvesting that removed the largest and oldest ponderosa pine trees from many stands. Tree ages measured in the old-growth stands in the Project Area range from 200 to more than 435 years. Of the 12,061 stands surveyed for old growth across the SJNF, seven have trees over 400 years old (FS and BLM 2003). Ponderosa pine trees typically remain dominant in these stands after timber harvest. However, the structure of old growth is altered, and some of the attributes of the habitat that make these areas important to wildlife are lost.

#### *3.8.2.8.3 Effects of CBM to Date*

One road that is used to access CBM wells, National Forest System Road (NFSR) 615, runs through an old-growth stand of ponderosa pine. This road was constructed before CBM development, probably to access timber stands and private land in-holdings. A CBM well pad and short segment of unnumbered road on the southern edge of the Project Area were also constructed in an old-growth stand of ponderosa pine. Collectively, these impacts have caused the loss of 10 acres of ponderosa pine old growth.

### 3.8.2.9 Ecological Processes and CBM Development

#### *3.8.2.9.1 Baseline*

Two ecological processes that may be affected by CBM development include fire regimes and insect and disease infestations in timber stands. The current fire management direction for federal lands in the Project Area allows for management, rather than immediate suppression, of natural (lightning-caused) fires when they will benefit the ecological health of the area. The Turkey Creek Fire (July 1997) is a recent example of a Project Area fire allowed to burn for resource benefit.

Another component of fire management is fuels reduction projects. Currently, four fuels reduction projects are planned for NFS lands in the Project Area during 2003:

- The Deer Valley thinning and mowing project in the northwestern portion of NFS lands in the Project Area.
- The Lange Canyon prescribed burn in the northern and northeastern portions of NFS lands in the Project Area.
- The Bull Canyon prescribed burn in the southeastern portion of NFS lands in the Project Area.
- The HD Fuels hydromowing project in the western and southwestern portion of NFS lands in the Project Area.

Several environmental factors, including drought and historical wildfire control, have led to *Ips* beetle, other insect, and black stain disease impacts. These insect and disease infestations have reached epidemic levels in the Project Area. The current outbreak has affected pinyon pine and, to a lesser extent, ponderosa pine in the Project Area. The outbreak has not yet reached a peak, meaning a larger number of trees in the Project Area could be affected, depending primarily on weather and secondarily on other factors such as predatory response from increased woodpecker populations.

The nearby Missionary Ridge Fire could worsen the insect outbreak by creating more dead and dying trees that would provide potential brood sites for *Ips* beetles and other insects. In addition, turpines (scent) that are released when pines are cut may attract beetles to surrounding areas. The beetles, which winter in many of the dead trees, are expected to emerge in early- to mid-May and spread into nearby healthy trees.

#### 3.8.2.9.2 Concerns

CBM development can affect fire and fire management in the Project Area by changing the historical role of fire. Proposed CBM development in the Project Area could conflict with current management direction on the National Forest portion of the Project Area that allows natural fire to burn in portions of the HD Mountains, to fulfill natural disturbance regimes.

Another conflict could occur when prescribed fire projects are ignited near CBM wells. There would be concern and pressure to protect these facilities from managed fires, adding cost and complexity to the project. At some times, conditions are too dry to allow naturally occurring fires to be managed for resource benefit, and the fire management strategy turns to full suppression. In these cases, roads associated with CBM development could provide quicker access to the fire and serve as fire breaks in the natural vegetation. In this case, the proposed road system would provide a benefit to fire management. In addition, the proposed road system would provide more opportunities for implementing and managing prescribed fires.

CBM development can contribute to the insect epidemic because trees and brush would be cut and stored temporarily during construction of facilities such as roads, pads, and pipelines. The trees and brush removed during construction must be handled properly so that they do not attract or provide brood sites for insects.

#### 3.8.2.9.3 Effects of CBM to Date

There is no documentation of CBM development having affected the ecological influences of fire, insects, and disease. The presence of CBM wells and other facilities is considered when wildland fires are reported nearby. These facilities are one of many factors used to select the appropriate management response to each wildland fire.

The overwhelming influence of the recent drought and other factors has obscured any potential effect of CBM development on outbreaks of insect and disease. As the number of wells, roads, and other facilities increases in the future, the possible effect of CBM development on these outbreaks may become more apparent.

## 3.8.2.10 Federally Listed Threatened and Endangered Plant Species

### 3.8.2.10.1 Baseline

Three species were evaluated because they may be affected by the proposed action or because habitat for these species may occur in the Project Area. Two of these species, Mancos milkvetch (*Astragalus humillimus*), and Mesa Verde cactus (*Sclerocactus mesae-verdae*), are not expected to occupy the area because the Project Area is either outside of their range or does not contain any potential habitat for them. These two species would not be affected by the proposed project, and a "no effect" determination is appropriate. These species have been eliminated from further detailed evaluation (Appendix H).

The remaining endangered plant, Knowlton's cactus, may occur in the Project Area based on the presence of suitable habitat for this species. Table 3–53 summarizes the species general habitat, potential for occurrence in the Project Area, and any known existing impacts that have occurred to this species because of past and on-going CBM development.

**Table 3–53 Federally Listed Threatened, Endangered, or Proposed Species of Plants**

| Species Name | General Habitat | Potential for Occurrence in the Project Area | Effects of CBM to Date |
|---|---|---|---|
| Knowlton's Cactus (*Pediocactus knowltonii*) | Alluvial deposits that form rolling gravelly hills covered with pinyon-juniper and sagebrush at 6,400 feet; occurs in La Plata County, near the Pine River, 5 miles south of the Project Area. | No known occurrences in the Project Area. Potential habitats, which may contain undocumented occurrences, exist in the Project Area. The extent of potential habitat is unknown. | No CBM-related effects to the known occurrence, which is located approximately 5 miles south of the Project Area, have been documented. |

### 3.8.2.10.2 Concerns

Well pad, pipeline, and road construction removes vegetation and soils. This disturbance, in turn, can cause direct mortality to individual plants, and the alteration of characteristics of the vegetation around the plants can also cause increased mortality and decreased reproduction. Degradation of habitat can prevent dispersal and establishment of individual plants.

Increased access to areas that contain rare plants, including Knowlton's cactus, can lead to an increase in collection, particularly for showy species or those of particular horticultural interest (such as cacti). Furthermore, some species can be difficult to identify outside of the flowering period. CBM development may cause loss of individuals or populations if clearance surveys are not conducted during the appropriate period.

Noxious weed invasion after ground disturbance can also affect sensitive, rare, and endangered plant species. As discussed in Section 3.8.2.7, noxious weeds can out-compete and potentially replace native plants, including sensitive, rare, and endangered species. Reproductive success and establishment of new plants can also be reduced. Finally, noxious weed control programs can inadvertently cause mortality of sensitive, rare, and endangered plants.

#### 3.8.2.10.3 Effects of CBM to Date

No CBM-related effects to Knowlton's cactus have been documented (Table 3–53).

### 3.8.2.11 Forest Service Sensitive Plant Species

#### 3.8.2.11.1 Baseline

All FS sensitive species listed as occurring or potentially occurring on the SJNF (FS 2001d) were evaluated for potential to occur in the Project Area. A number of these species are not expected to occupy the area because the Project Area is either outside of their range or does not contain any potential habitat. Species eliminated from further detailed evaluation include: southern maidenhair fern (*Adiantum capillus-veneris*), reflected moonwort (*Botrychium echo*), pale moonwort (*Botrychium pallidum*), Altai cotton-grass (*Eriophorum altaicum* var. *neogaeum*), and Colorado tansy-aster (*Machaeranthera coloradoensis*). This group of species would not be affected by the proposed project, and a "no impact" determination is appropriate.

The remaining FS sensitive plants may occur in the Project Area, either because there are known occurrences of the species, or there is suitable habitat present for these species. Table 3–54 summarizes the general habitat, the potential for occurrence in the Project Area, and any known existing effects to these species caused by past and on-going CBM development. Appendix I presents general information about the species, including their status, distribution, life history, and factors of concern.

#### 3.8.2.11.2 Concerns

Concerns for these and other special status plant species are discussed in Section 3.8.2.10.2.

#### 3.8.2.11.3 Effects of CBM to Date

No CBM-related effects to any of the FS sensitive species of plants have been documented (Table 3–54).

### 3.8.2.12 Bureau of Land Management Sensitive Plant Species

#### 3.8.2.12.1 Baseline

All BLM sensitive plant species known to occur within the area administered by the San Juan Field Office were evaluated for their potential to occur in the Project Area. A number of these species are not expected to occur because the Project Area is either outside of their range or does not contain any potential habitat. The following species have been eliminated from detailed evaluation: Cronquist milk-vetch (*Astragalus cronquistii*), Naturita milk-vetch (*Astragalus naturiten-*

*sis*), kachina daisy (*Erigeron kachinensis*), and Comb Wash buckwheat (*Eriogonum clavellatum*).

**Table 3–54 FS Sensitive Species of Plants**

| Species Name | General Habitat | Potential for Occurrence in the Project Area | Effects of CBM to Date |
|---|---|---|---|
| Aztec Milk-vetch (*Astragalus proximus*) | Mesas, bluffs, and low hills in sandy, often alkaline clay soils in junipers or sagebrush at 5,400 to 7,300 feet; occurs in La Plata and Archuleta Counties. | Several occurrences of this species are known in the Project Area. Potential habitats, which occupy 10,090 acres, may contain undocumented occurrences. | No CBM-related effects to the known occurrences have been documented. |
| Giant Helleborine (*Epipactus gigantea*) | Seeps on sandstone cliffs and hillsides, and springs at 4,800 to 8,000 feet; occurs in Archuleta, 5 miles north of the Project Area, and in Chaffee, Delta, Mesa, Moffat, Montezuma, Montrose, and Saguache Counties. | No known occurrences in the Project Area. Potential habitats, which occupy 26 acres, may contain undocumented occurrences. | No CBM-related effects to the known occurrences have been documented. |
| Pagosa Skyrocket (*Ipomopsis polyantha* var. *polyantha*) | Fine-textured soils derived from the Mancos formation or barren shales, pinyon-juniper, ponderosa pine, or scrub oak communities, between 6,800 and 7,200 feet; endemic to the Pagosa Springs area, 10 miles east of the Project Area. | No known occurrences in the Project Area. Potential habitats, which occupy 38,800 acres, may contain undocumented occurrences. | No CBM-related effects to the known occurrences have been documented. |
| Pagosa Springs Bladderpod (*Lesquerella pruinosa*) | Barren areas surrounded by montane grasslands, open ponderosa pine stands with scrub oak, or Douglas fir on fine-textured soils derived from Mancos Formation shale at 6,800 to 8,300 feet; endemic to Archuleta County, in the Pagosa Springs area. | No known occurrences in the Project Area. Potential habitats, which occupy 32,668 acres, may contain undocumented occurrences. | No CBM-related effects to the known occurrences have been documented. |

Two BLM sensitive plant species, Pagosa skyrocket and Pagosa bladderpod, may occur in the Project Area based either on known occurrences of the species or the presence of suitable habitats for these plants. Table 3–54 summarizes their general habitats, the potential for occurrence in the Project Area, and any known, existing effects that have occurred to these species because of past and on-going CBM development. Appendix K presents the status, distribution (including potential occurrence), life history (including general habitat), and factors of concern (including existing effects from past and on-going CBM development) for each of these species.

### 3.8.2.12.2 Concerns

Concerns for these and other special status plant species are discussed in Section 3.8.2.10.2.

#### *3.8.2.12.3 Effects of CBM to Date*

No CBM-related effects to any of the BLM sensitive species of plants have been documented (Table 3–54).

## 3.8.3 Environmental Consequences

Well pad, compressor station, pipeline, and road construction would all clear vegetation from impacted sites. Subsequently, portions of these facilities would be reclaimed within 1 to 3 years following construction. Interim reclamation would establish grasses and other herbaceous species in disturbed areas and generally would not attempt to replace forested areas or shrublands where these vegetation types were present before disturbance.

The remainder of the area where vegetation is removed would be used during the construction and production phases of the project. This area would remain devoid of vegetation for the 25- to 30-year life of the project. Most roads and well pads would be reclaimed during the abandonment phase of the project. After Project completion, there would be some permanent loss of vegetation for roads placed on the permanent road system that are not reclaimed. The Recreation section displays the location and extent of these remaining roads and facilities which would be a small proportion of the total amount of disturbance. Final reclamation would attempt to replace forested areas and shrublands where these vegetation types were present before disturbance. Complete restoration of pre-disturbance vegetation in the structural stages that were removed would require decades.

Vegetation would be affected in several other ways. Wetlands and riparian areas are fragile vegetation types that may be crossed by roads and pipelines. Project activities have the potential to introduce and spread noxious weeds. Portions of old-growth ponderosa pine stands may be removed by construction. Ecological processes, such as fire regime and insects and disease, may be altered. Finally, threatened, endangered, and sensitive plant species may be affected. The following sections discuss the specific effects to vegetation from each of these factors.

### 3.8.3.1 Vegetation Disturbance and CBM Development

Table 3–55 through Table 3–61 show the maximum amount of each vegetation type that would be removed under each alternative.. Interim reclamation would occur for a portion of this disturbance, thus reducing the acreage impacted over the long-term production phase of the project. Alternative 2 would remove the largest amount of vegetation followed in descending order by Alternatives 1, 1A, 1B, 3, 4 and 5.

The largest amounts of vegetation removal would occur in the Gambel oak, pinyon-juniper, and ponderosa pine types. These types are also among the most common in the Project Area; however, the proportion of these types that would be removed is also higher than for other types. In all cases, only a relatively small proportion of each type, less than 2 percent, would be removed. Table 3–55 through Table 3–61 show the proportion of each vegetation type that would be impacted by the alternatives.

### Table 3–55 CBM Development Impacts to Vegetation — Alternative 1

| Vegetation Type | Areal Extent of Disturbance NF (acres) | BLM (acres) | State (acres) | Private (acres) | Total (acres) | Portion of Vegetation Type (percent) |
|---|---|---|---|---|---|---|
| Grasslands | 50 | 3 | 0 | 10 | 63 | 0.5 |
| Sagebrush | 23 | 0 | 0 | 44 | 67 | 0.6 |
| Pinyon-Juniper | 112 | 13 | 5 | 86 | 215 | 0.8 |
| Mountain Shrub | 2 | 3 | 0 | 5 | 10 | 0.4 |
| Gambel Oak | 106 | 4 | 7 | 23 | 140 | 0.7 |
| Ponderosa Pine | 351 | 4 | 9 | 26 | 390 | 1.1 |
| Mixed Conifer | 60 | 0 | 0 | 0 | 60 | 1.3 |
| Aspen | 15 | 0 | 0 | 0 | 15 | 1.2 |
| Riparian | 0 | 0 | 0 | 3 | 3 | 0.4 |
| Agriculture | 0 | 3 | 0 | 39 | 42 | 0.5 |
| Barren | 3 | 0 | 1 | 5 | 10 | 0.4 |
| Water | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Total | 722 | 31 | 22 | 241 | 1,016 | 0.8 |

### Table 3–56 CBM Development Impacts to Vegetation — Alternative 1A

| Vegetation Type | Areal Extent of Disturbance NF (acres) | BLM (acres) | State (acres) | Private (acres) | Total (acres) | Portion of Vegetation Type (percent) |
|---|---|---|---|---|---|---|
| Grasslands | 32 | 3 | 0 | 10 | 46 | 0.4 |
| Sagebrush | 18 | 0 | 0 | 44 | 62 | 0.5 |
| Pinyon-Juniper | 71 | 13 | 5 | 86 | 174 | 0.7 |
| Mountain Shrub | 2 | 3 | 0 | 5 | 10 | 0.4 |
| Gambel Oak | 84 | 4 | 7 | 21 | 116 | 0.6 |
| Ponderosa Pine | 301 | 4 | 9 | 26 | 340 | 1.0 |
| Mixed Conifer | 48 | 0 | 0 | 0 | 48 | 1.1 |
| Aspen | 15 | 0 | 0 | 0 | 15 | 1.2 |
| Riparian | 0 | 0 | 0 | 3 | 3 | 0.4 |
| Agriculture | 0 | 3 | 0 | 41 | 44 | 0.5 |
| Barren | 4 | 0 | 1 | 5 | 11 | 0.5 |
| Water | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Total | 575 | 31 | 21 | 241 | 869 | 0.7 |

## Table 3–57 CBM Development Impacts to Vegetation — Alternative 1B

| | Areal Extent of Disturbance | | | | | Portion of |
|---|---|---|---|---|---|---|
| Vegetation Type | NF (acres) | BLM (acres) | State (acres) | Private (acres) | Total (acres) | Vegetation Type (percent) |
| Grasslands | 22 | 3 | 0 | 10 | 36 | 0.3 |
| Sagebrush | 14 | 0 | 0 | 44 | 58 | 0.5 |
| Pinyon-Juniper | 50 | 13 | 4 | 84 | 152 | 0.6 |
| Mountain Shrub | 2 | 3 | 0 | 5 | 10 | 0.4 |
| Gambel Oak | 33 | 4 | 1 | 18 | 57 | 0.3 |
| Ponderosa Pine | 203 | 4 | 6 | 25 | 239 | 0.7 |
| Mixed Conifer | 13 | 0 | 0 | 0 | 13 | 0.3 |
| Aspen | 13 | 0 | 0 | 0 | 13 | 1.0 |
| Riparian | 0 | 0 | 0 | 3 | 3 | 0.4 |
| Agriculture | 0 | 3 | 0 | 39 | 42 | 0.5 |
| Barren | 5 | 0 | 1 | 5 | 11 | 0.5 |
| Water | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Total | 356 | 31 | 13 | 233 | 634 | 0.5 |

## Table 3–58 CBM Development Impacts to Vegetation — Alternative 2

| | Areal Extent of Disturbance | | | | | Portion of |
|---|---|---|---|---|---|---|
| Vegetation Type | NF (acres) | BLM (acres) | State (acres) | Private (acres) | Total (acres) | Vegetation Type (percent) |
| Grasslands | 72 | 3 | 3 | 50 | 128 | 1.0 |
| Sagebrush | 23 | 6 | 0 | 65 | 94 | 0.8 |
| Pinyon-Juniper | 207 | 22 | 5 | 127 | 361 | 1.4 |
| Mountain Shrub | 10 | 6 | 5 | 21 | 42 | 1.6 |
| Gambel Oak | 235 | 4 | 10 | 75 | 325 | 1.7 |
| Ponderosa Pine | 484 | 10 | 14 | 81 | 589 | 1.7 |
| Mixed Conifer | 80 | 0 | 0 | 5 | 85 | 1.9 |
| Aspen | 27 | 0 | 0 | 3 | 29 | 2.2 |
| Riparian | 0 | 0 | 0 | 3 | 3 | 0.4 |
| Agriculture | 0 | 3 | 5 | 63 | 71 | 0.8 |
| Barren | 7 | 6 | 1 | 5 | 20 | 0.8 |
| Water | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Total | 1,145 | 61 | 42 | 497 | 1,746 | 1.4 |

## Table 3–59 CBM Development Impacts to Vegetation — Alternative 3

| | Areal Extent of Disturbance | | | | | Portion of |
|---|---|---|---|---|---|---|
| Vegetation Type | NF (acres) | BLM (acres) | State (acres) | Private (acres) | Total (acres) | Vegetation Type (percent) |
| Grasslands | 43 | 3 | 0 | 13 | 59 | 0.5 |
| Sagebrush | 23 | 0 | 0 | 44 | 67 | 0.6 |
| Pinyon-Juniper | 64 | 13 | 5 | 86 | 168 | 0.6 |
| Mountain Shrub | 1 | 3 | 0 | 5 | 10 | 0.4 |
| Gambel Oak | 29 | 4 | 9 | 21 | 63 | 0.3 |
| Ponderosa Pine | 218 | 4 | 10 | 26 | 258 | 0.7 |
| Mixed Conifer | 20 | 0 | 0 | 0 | 20 | 0.4 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Riparian | 0 | 0 | 0 | 3 | 3 | 0.4 |
| Agriculture | 0 | 3 | 0 | 39 | 42 | 0.5 |
| Barren | 3 | 0 | 1 | 3 | 7 | 0.3 |
| Water | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Total | 402 | 31 | 24 | 239 | 696 | 0.6 |

## Table 3–60 CBM Development Impacts to Vegetation — Alternative 4

| | Areal Extent of Disturbance | | | | | Portion of |
|---|---|---|---|---|---|---|
| Vegetation Type | NF (acres) | BLM (acres) | State (acres) | Private (acres) | Total (acres) | Vegetation Type (percent) |
| Grasslands | 33 | 3 | 0 | 14 | 50 | 0.4 |
| Sagebrush | 4 | 0 | 0 | 44 | 49 | 0.4 |
| Pinyon-Juniper | 99 | 13 | 1 | 84 | 197 | 0.8 |
| Mountain Shrub | 3 | 3 | 0 | 5 | 11 | 0.4 |
| Gambel Oak | 62 | 4 | 6 | 23 | 95 | 0.5 |
| Ponderosa Pine | 174 | 4 | 7 | 28 | 213 | 0.6 |
| Mixed Conifer | 38 | 0 | 0 | 0 | 38 | 0.8 |
| Aspen | 2 | 0 | 0 | 0 | 2 | 0.2 |
| Riparian | 0 | 0 | 0 | 3 | 3 | 0.4 |
| Agriculture | 0 | 3 | 0 | 41 | 44 | 0.5 |
| Barren | 4 | 0 | 1 | 3 | 8 | 0.3 |
| Water | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Total | 419 | 31 | 16 | 244 | 710 | 0.6 |

Table 3–61 **CBM Development Impacts to Vegetation — Alternative 5**

| | Areal Extent of Disturbance | | | | | Portion of Vegetation Type |
|---|---|---|---|---|---|---|
| Vegetation Type | NF (acres) | BLM (acres) | State (acres) | Private (acres) | Total (acres) | (percent) |
| Grasslands | 5 | 0 | 0 | 16 | 21 | 0.2 |
| Sagebrush | 2 | 0 | 0 | 53 | 55 | 0.5 |
| Pinyon-Juniper | 6 | 0 | 4 | 84 | 94 | 0.4 |
| Mountain Shrub | 0 | 0 | 0 | 5 | 5 | 0.2 |
| Gambel Oak | 5 | 0 | 6 | 18 | 30 | 0.2 |
| Ponderosa Pine | 70 | 0 | 7 | 29 | 105 | 0.3 |
| Mixed Conifer | 3 | 0 | 0 | 0 | 3 | 0.1 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Riparian | 0 | 0 | 0 | 3 | 3 | 0.4 |
| Agriculture | 0 | 0 | 0 | 39 | 39 | 0.4 |
| Barren | 0 | 0 | 1 | 5 | 7 | 0.3 |
| Water | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Total | 91 | 0 | 19 | 251 | 362 | 0.3 |

## 3.8.3.2 Habitat Structural Stages

Each alternative would impact several HSSs in each vegetation type on NFS lands by removing vegetation (Table 3–62 through Table 3–68). Similar impacts would occur throughout the Project Area (Table 3–69 through Table 3–75. The alternatives would impact disproportionately certain HSSs, such as 4A and 4B ponderosa pine. Between 2 and 3 percent of the 4A and 4B ponderosa pine structural stages would be affected under Alternative 2, which would have the most impacts on these HSSs. A smaller proportion of these HSSs would be affected under the other six alternatives. No more than 3 percent of any HSS in any vegetation type would be affected by any of the alternatives.

Areas reclaimed after CBM development often differ substantially from undisturbed areas in terms of HSS. Reclaimed areas may not serve functions now fulfilled by undisturbed vegetation communities, particularly in the first few years, when species composition, shrub and tree cover, and other environmental factors would likely be different. Development of shrub and tree cover would require an extended period and may not be complete until decades after project facilities have been abandoned. Reclaimed areas would initially be in early seral HSSs, but would eventually develop into late seral HSSs in the absence of other disturbances.

### Table 3–62 CBM Impacts to Habitat Structural Stages on NFS Lands — Alternative 1

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 43 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 |
| Sagebrush | 0 | 0 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 24 | 65 | 0 | 15 | 8 | 0 | 0 | 112 |
| Mountain Shrub | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Gambel Oak | 0 | 0 | 0 | 106 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 106 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 148 | 161 | 0 | 36 | 351 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 7 | 36 | 11 | 0 | 60 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 5 | 0 | 0 | 15 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barren | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 3 | 43 | 6 | 131 | 0 | 24 | 87 | 1 | 170 | 210 | 11 | 36 | 722 |

### Table 3–63 CBM Impacts to Habitat Structural Stages on NFS Lands — Alternative 1A

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 32 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32 |
| Sagebrush | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 15 | 37 | 0 | 12 | 6 | 0 | 0 | 71 |
| Mountain Shrub | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Gambel Oak | 0 | 0 | 0 | 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 84 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 123 | 140 | 0 | 31 | 301 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 4 | 26 | 11 | 0 | 48 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 5 | 0 | 0 | 15 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barren | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 4 | 32 | 1 | 104 | 0 | 16 | 61 | 1 | 139 | 177 | 11 | 31 | 575 |

### Table 3–64 CBM Impacts to Habitat Structural Stages on NFS Lands — Alternative 1B

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 17 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 |
| Sagebrush | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 9 | 23 | 0 | 12 | 6 | 0 | 0 | 50 |
| Mountain Shrub | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Gambel Oak | 0 | 0 | 0 | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 4 | 5 | 0 | 89 | 90 | 0 | 15 | 203 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 10 | 0 | 0 | 13 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 4 | 0 | 0 | 13 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barren | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 5 | 17 | 5 | 49 | 0 | 14 | 40 | 0 | 102 | 109 | 0 | 15 | 356 |

### Table 3–65 CBM Impacts to Habitat Structural Stages on NFS Lands — Alternative 2

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 66 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 72 |
| Sagebrush | 0 | 0 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 47 | 96 | 0 | 34 | 31 | 0 | 0 | 207 |
| Mountain Shrub | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Gambel Oak | 0 | 0 | 0 | 228 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 235 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 4 | 9 | 0 | 251 | 183 | 0 | 36 | 484 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 18 | 40 | 11 | 0 | 80 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 8 | 10 | 0 | 4 | 5 | 0 | 0 | 27 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barren | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 7 | 66 | 6 | 261 | 8 | 58 | 125 | 1 | 308 | 259 | 11 | 36 | 1,145 |

## Table 3–66 CBM Impacts to Habitat Structural Stages on NFS Lands — Alternative 3

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 37 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 43 |
| Sagebrush | 0 | 0 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 18 | 32 | 0 | 7 | 7 | 0 | 0 | 64 |
| Mountain Shrub | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Gambel Oak | 0 | 0 | 0 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 83 | 116 | 0 | 14 | 218 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 3 | 16 | 0 | 0 | 20 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barren | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 3 | 37 | 6 | 54 | 0 | 18 | 39 | 0 | 93 | 139 | 0 | 14 | 402 |

## Table 3–67 CBM Impacts to Habitat Structural Stages on NFS Lands — Alternative 4

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 24 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |
| Sagebrush | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 27 | 46 | 0 | 15 | 11 | 0 | 0 | 99 |
| Mountain Shrub | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Gambel Oak | 0 | 0 | 0 | 58 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 62 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 0 | 73 | 80 | 0 | 14 | 174 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 8 | 20 | 4 | 0 | 38 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barren | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 4 | 24 | 10 | 66 | 4 | 30 | 57 | 0 | 96 | 110 | 4 | 14 | 419 |

## Table 3–68 CBM Impacts to Habitat Structural Stages on NFS Lands — Alternative 5

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| Sagebrush | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 0 | 0 | 1 | 0 | 0 | 6 |
| Mountain Shrub | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gambel Oak | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 30 | 37 | 0 | 0 | 70 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 3 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barren | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 5 | 0 | 7 | 0 | 1 | 9 | 0 | 30 | 39 | 0 | 0 | 91 |

## Table 3–69 CBM Impacts to Habitat Structural Stages in the Project Area — Alternative 1

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 53 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 63 |
| Sagebrush | 0 | 0 | 0 | 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 67 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 47 | 113 | 0 | 34 | 21 | 0 | 0 | 215 |
| Mountain Shrub | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Gambel Oak | 0 | 0 | 0 | 139 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 140 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 1 | 7 | 0 | 167 | 178 | 0 | 38 | 390 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 7 | 36 | 11 | 0 | 60 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 5 | 0 | 0 | 15 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 3 |
| Agriculture | 42 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42 |
| Barren | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 52 | 53 | 10 | 217 | 1 | 48 | 136 | 1 | 210 | 240 | 11 | 38 | 1,016 |

## Table 3–70 CBM Impacts to Habitat Structural Stages in the Project Area — Alternative 1A

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 41 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 46 |
| Sagebrush | 0 | 0 | 0 | 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 62 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 39 | 85 | 0 | 31 | 20 | 0 | 0 | 174 |
| Mountain Shrub | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Gambel Oak | 0 | 0 | 0 | 116 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 116 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 1 | 7 | 0 | 142 | 156 | 0 | 33 | 340 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 4 | 26 | 11 | 0 | 48 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 5 | 0 | 0 | 15 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 3 |
| Agriculture | 44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44 |
| Barren | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 55 | 41 | 4 | 188 | 1 | 39 | 110 | 1 | 179 | 207 | 11 | 33 | 869 |

## Table 3–71 CBM Impacts to Habitat Structural Stages in the Project Area — Alternative 1B

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 27 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 36 |
| Sagebrush | 0 | 0 | 0 | 58 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 58 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 32 | 70 | 0 | 30 | 19 | 0 | 0 | 152 |
| Mountain Shrub | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Gambel Oak | 0 | 0 | 0 | 56 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 57 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 5 | 6 | 0 | 106 | 105 | 0 | 16 | 239 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 10 | 0 | 0 | 13 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 4 | 0 | 0 | 13 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 3 |
| Agriculture | 42 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42 |
| Barren | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 54 | 27 | 9 | 125 | 1 | 37 | 88 | 0 | 139 | 138 | 0 | 16 | 634 |

## Table 3–72 CBM Impacts to Habitat Structural Stages in the Project Area — Alternative 2

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 106 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 128 |
| Sagebrush | 0 | 0 | 0 | 94 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 94 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 81 | 167 | 0 | 62 | 51 | 0 | 0 | 361 |
| Mountain Shrub | 0 | 0 | 0 | 42 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42 |
| Gambel Oak | 0 | 0 | 0 | 315 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 325 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 5 | 12 | 0 | 302 | 228 | 1 | 40 | 589 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 19 | 43 | 11 | 0 | 85 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 8 | 11 | 0 | 4 | 6 | 0 | 0 | 29 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 3 |
| Agriculture | 71 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 71 |
| Barren | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 91 | 106 | 22 | 451 | 10 | 95 | 202 | 1 | 390 | 328 | 12 | 40 | 1,746 |

## Table 3–73 CBM Impacts to Habitat Structural Stages in the Project Area — Alternative 3

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 48 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 59 |
| Sagebrush | 0 | 0 | 0 | 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 67 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 41 | 80 | 0 | 26 | 21 | 0 | 0 | 168 |
| Mountain Shrub | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Gambel Oak | 0 | 0 | 0 | 62 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 63 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 1 | 7 | 0 | 102 | 133 | 0 | 15 | 258 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 3 | 16 | 0 | 0 | 20 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 3 |
| Agriculture | 42 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42 |
| Barren | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 49 | 48 | 11 | 139 | 1 | 42 | 89 | 0 | 133 | 169 | 0 | 15 | 696 |

## Table 3–74 CBM Impacts to Habitat Structural Stages in the Project Area — Alternative 4

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 36 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 |
| Sagebrush | 0 | 0 | 0 | 49 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 49 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 49 | 92 | 0 | 33 | 23 | 0 | 0 | 197 |
| Mountain Shrub | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Gambel Oak | 0 | 0 | 0 | 90 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 95 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 2 | 6 | 0 | 92 | 96 | 0 | 16 | 213 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 8 | 20 | 4 | 0 | 38 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 3 |
| Agriculture | 44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44 |
| Barren | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 52 | 36 | 14 | 150 | 5 | 53 | 104 | 0 | 135 | 140 | 5 | 16 | 710 |

## Table 3–75 CBM Impacts to Habitat Structural Stages in the Project Area — Alternative 5

| | Habitat Structural Stage (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0 | 16 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 |
| Sagebrush | 0 | 0 | 0 | 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 |
| Pinyon-Juniper | 0 | 0 | 0 | 0 | 0 | 21 | 45 | 0 | 16 | 13 | 0 | 0 | 94 |
| Mountain Shrub | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| Gambel Oak | 0 | 0 | 0 | 29 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 |
| Ponderosa Pine | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 47 | 52 | 0 | 1 | 105 |
| Mixed Conifer | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 3 |
| Aspen | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 3 |
| Agriculture | 39 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 |
| Barren | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 46 | 16 | 4 | 90 | 1 | 21 | 51 | 0 | 65 | 66 | 0 | 1 | 362 |

### 3.8.3.3 Wetlands, Riparian Areas, and CBM Development

Potential wetlands and riparian area impacts include direct loss due to road, well pad, and other facilities construction; degradation due to sediment produced from facilities; and reduction of surface water and groundwater flows resulting from dewatering the Fruitland formation.

Loss of wetlands and riparian areas may occur despite the intention to avoid these environmentally sensitive areas where possible. Well pads and compressor stations would be located in upland sites where they would not directly impact wetlands and riparian areas.

Linear facilities would be constructed across intermittent streams, and would avoid perennial streams and rivers in the Project Area. Wetlands and riparian areas are most common and generally best developed along perennial streams. Wetlands and riparian areas may also develop along intermittent streams. Alternatives with larger numbers of wells and associated roads are more likely to affect wetlands and riparian areas than are alternatives with fewer wells. Table 3–76 shows the approximate number of crossings of intermittent streams for each of the alternatives.

Areas excavated for utility pipelines would be restored immediately after construction, and most roads would be restored when the project is eventually abandoned, reducing wetland sedimentation. However, some level of impact would persist indefinitely and surface disturbances and related impacts to water quality should be considered long-term effects.

**Table 3–76 Impacts Contributing to Potential Effects to Streams in the Project Area**

| Alternative | Disturbance[1] (acres) | New Road (miles) | Stream Crossings[2] | Score[3] | Rank[4] |
|---|---|---|---|---|---|
| 1 | 1,039 | 100 | 173 | 615 | 2 |
| 1A | 809 | 74 | 128 | 459 | 3 |
| 1B | 728 | 57 | 99 | 364 | 6 |
| 2 | 1,736 | 177 | 306 | 1,079 | 1 |
| 3 | 680 | 61 | 106 | 380 | 5 |
| 4 | 692 | 75 | 130 | 453 | 4 |
| 5 | 376 | 31 | 54 | 196 | 7 |

Notes:
1. Sedimentation risk index: a relative comparison of surface disturbances as related to sediment production.
2. "Stream Crossings" estimates new road intersections with intermittent drainages.
3. Scores are weighted to reflect relative importance of metrics.
4. (Rank of 1 = greatest risk, 7 = lowest risk.)

Watershed mitigation measures (BMPs) described in Section 3.8.5, Section 3.6 (Surface Water Resources), and Section 3.5 (Soils) are designed to reduce sediment inputs to surface waters. The magnitude and duration of sediment impacts would depend on the long-term effectiveness of these sediment controls. Assuming BMPs are properly implemented, monitored, and maintained, the effects of CBM-related sedimentation to wetlands and riparian areas would be minimized.

Fill of wetlands or waters of the U.S. (which typically include non-wetland riparian areas) would be regulated through the COE permitting process. Most impacts would be covered under current Nationwide Permits (primarily Nationwide Permits 12 and 14), although individual permits may be required for larger impacts. To date, the companies have not been required to obtain individual permits (McWhirter 2003); therefore, the types of impacts that trigger individual permits are not anticipated under any of the alternatives.

Roads may increase sedimentation and surface water flows to wetlands and riparian areas. Roads built within floodplains can redirect water, sediment, and nutrients among streams, wetlands, and riparian ecosystems to the detriment of water quality and health of the ecosystem (Trombulak and Frissell 2000). The Surface Water section of this Chapter analyzes the relationship between surface water quality and facility construction within watersheds in the Project Area. Table 3–76 shows the length of new road construction and the areal extent of surface disturbance that are anticipated under each alternative. In general, both of these analyses show that greater potential sedimentation impacts would occur to surface water under alternatives that involve more wells and other facilities, such as Alternatives 1 and 2.

Continued de-watering of the Fruitland Formation may reduce the availability of water in streams, seeps, and springs that support wetlands and riparian areas. However, de-watering is expected to negligibly affect surface water flows because the predicted depletions would be very minor in relation to base flows (Section 3.6). Consequently, wetlands and riparian areas that depend on surface water flows are unlikely to be affected by changes in availability of water associated with any of the alternatives. De-watering may, however, affect flows of seeps and springs located along the outcrops of the Fruitland and Pictured Cliffs Formation (Section 3.6). At these outcrop locations, pumping groundwater for CBM extraction may cause flows of seeps and springs to decrease or stop altogether, impacting riparian and wetland vegetation that depends on the seeps and springs. Similar effects to seeps and springs are predicted for each alternative (Section 3.6).

### 3.8.3.4 Vegetation Restoration and CBM Development

As wells reach the end of their economic lives, most facilities would be removed and the disturbed areas would be restored and returned to pre-project uses. This analysis assumes that most new roads would be removed at abandonment; however, a residual road system would remain open for other uses.

Restoration typically includes replacing salvaged topsoil, re-grading where necessary, reseeding disturbed areas, and controlling noxious weeds. Complete restoration of some native vegetation types, particularly shrublands and forested areas, would, however, take decades because of the slow recruitment of native vegetation. Forested areas, shrublands, and even native grasslands would display lower species diversity than the pre-disturbance sites until natural recruitment re-establishes the pre-disturbance level of diversity. As a result, the ecological attributes of the native vegetation would not be restored for a period of decades to centuries in some cases. For example, old-growth ponderosa pine forests would not become re-established for centuries.

Current federal land policy requires use of native plant species in restoration to the extent practicable. The priority is to allow natural revegetation where a source of seed is present, soil conditions are favorable, and noxious weeds are not expected to be a problem. Natural revegetation would not be short cutted where noxious weeds may be spread and erosion must be controlled through interim and final reclamation. Where active restoration is needed, native plants from a local source are preferred. In the absence of local native plants, non-local native or preferred non-native plants may be used with certain constraints. Certified seed is required, and certain non-native aggressive or persistent species may not be used (FS 2003c). These guidelines would be followed to the extent practical.

Vegetation restoration would be required for each site under each alternative. Alternatives that involve larger amounts of ground disturbance, such as Alternative 2, would require a greater amount of restoration. In addition, the potential for unsuccessful restoration would increase with increased development. Similarly, larger amounts of disturbance increase the potential for noxious weed species to become established and spread.

### 3.8.3.5 Noxious Weeds and CBM Development

Perhaps the greatest effect of CBM development on vegetation is the potential introduction and spread of noxious weeds around project facilities. Removal of native vegetation associated with construction of well pads, compressor stations, roads, and other facilities would enhance opportunities for invasion and establishment of noxious weeds. However, the extent of these invasions is difficult to predict and would be influenced by many factors. These factors include the extent of disturbed areas, the extent of existing infestations of weeds that would provide a source of seeds, the amount of equipment moving from areas that are infested with weeds to areas that are not yet infested, the effectiveness of mitigation measures designed to prevent infestations of noxious weeds, and the time lag between the end of disturbance and successful completion of restoration.

Motor vehicles are one of the primary mechanisms for dispersal of seeds for noxious weeds. Historically, recreational vehicles (motorcycles, ATVs, and 4-wheel drive vehicles) have been a main vector for the spread of undesirable seed. When vehicles are driven through weed-infested areas, seed may become lodged in the treads of tires or the undercarriage, or may stick to vehicles that are splattered with mud. For this reason, vehicles that traverse any portion of the Project Area would become a potential vector for further noxious weeds infestations.

Noxious weeds have the ability to displace native vegetation and hinder restoration efforts. Minimizing establishment and spread of unwanted invasive species on or near disturbed areas would therefore be of critical importance after restoration efforts have begun. Effective restoration of disturbed sites is best achieved when natural vegetative succession develops unimpeded by invasion of undesirable plant species. Desirable species, such as in a native seed mix or the pioneer species surrounding the site, are not able to compete when disturbed sites are infested with noxious weeds, thereby disrupting the successional balance necessary to restore the native plant community. The use of an approved, native seed mix for restoration, as discussed in Section 3.8.3.4, would help to reduce the potential for invasion by noxious weeds.

Weed seeds may be introduced accidentally with any project activity under any alternative. The probability that noxious weeds would be introduced cannot be quantitatively predicted; however, infestations of noxious weeds have been found in association with ground disturbance from existing CBM development on federal and private lands in the Project Area. Control of existing noxious weed infestations on federal lands has generally been successful (Wood 2003), while results have been mixed on private lands (Cook 2002b). The potential for noxious weeds to establish and spread would generally be highest for alternatives that cause the greatest amount of ground disturbance, such as Alternative 2, and lowest for alternatives that cause less ground disturbance, such as Alternative 5. Mitigation measures designed to prevent the introduction and spread of noxious weeds would be implemented under all alternatives; however, complete prevention and control of weeds is unlikely.

### 3.8.3.6 Old-Growth Ponderosa Pine and CBM Development

Some old-growth stands of ponderosa pine on NFS lands in the Project Area would be impacted under all alternatives, except Alternative 5. Table 3–77 shows the number of acres and stands of old-growth ponderosa pine that would be impacted by roads and well pads. No other facilities, such as compressors or disposal wells, would be constructed in old-growth stands.

**Table 3–77 CBM Impacts to Old-Growth Ponderosa Pine by Alternative**

| | Alternative | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Old Growth Ponderosa Pine | 1 | 1A | 1B | 2 | 3 | 4 | 5 | Existing Resources |
| NFS Lands | | | | | | | | |
| Acres Affected | 36 | 31 | 15 | 36 | 14 | 14 | 0 | 746 acres |
| Proportion of Acres Affected | 4.8 | 4.2 | 2.0 | 4.8 | 1.9 | 1.9 | 0.0 | |
| Stands Cumulatively Affected[1] | 13 | 13 | 6 | 13 | 4 | 5 | 3 | 15 stands[1] |
| Proportion of Stands Cumulatively Affected[1] | 86.7 | 86.7 | 40.0 | 86.7 | 26.7 | 33.3 | 20.0 | |
| All Lands | | | | | | | | |
| Acres Affected | 38 | 33 | 16 | 40 | 15 | 16 | 1 | 1,335 acres |
| Proportion of Acres Affected | 2.8 | 2.5 | 1.2 | 3.0 | 1.1 | 1.2 | 0.1 | |

Notes:
1. Stand data are available on NFS lands only.

Old-growth stands in the HD Mountains typically occupy relatively flat areas, which capture and hold more moisture than do steep hillsides. The preferred position for well pads is also on these relatively flat sites to avoid creating steep cut banks and associated erosion. Because opportunities for avoidance are constrained by terrain features, well pad and road construction along the Pine Piedra Stock Driveway cannot totally avoid old growth and would eliminate some very old and large trees, or clumps of trees (some measuring 400-years+).

Depending upon the ultimate location of roads and well pads and the size and shape of the stands, old growth stands may be impacted in various ways. Beyond direct removal, the functions and values of affected stands may be decreased or lost. Roads and well pads may fragment stands of old growth, increase the amount of edge, and change the physical and biological environment of the stand. The portion of the stand nearest the disturbed areas would become warmer and dryer. More light and wind would penetrate the stand. These physical effects would favor plants and wildlife that are adapted to these conditions and tend to exclude species common to the interior of the forest (Noss and Cooperrider 1994) (See also the Wildlife section of this chapter and Appendix J). These effects may continue into the stand for some distance beyond the area where vegetation is removed, up to two to three times the average tree height (Harris 1984). The entire area may become edge in small or narrow stands, while in larger stands the amount of interior habitat can be noticeably reduced (Meffe and Carroll 1994). Fragmentation reduces the total area of the original habitat and may isolate populations dependent on the remaining patches. The extent of these potential impacts would depend on the size and configuration of the impacted old-growth stand and the location of the impacting structure. Steps would-be taken to avoid old-growth stands where terrain limitations do not create unacceptable tradeoffs.

The alternatives would directly affect old growth stands (Table 3–77), impacting from zero acres (Alternative 5) to 36 acres of old growth pine (Alterntives 1 and 2). Alternative 2 would result in the largest impact followed in descending order by Alternatives 1, 1A, 1B, 3, 4, and 5. This represents from zero to 4.8 percent of old-growth acres inventoried within the national forest portion of the Project Area. Mitigation would be undertaken during road and well pad staking to reduce the extent of this impact. However, until firm locations are proposed during APD submittal, our effective ability to move facilities to avoid old-growth impact is unknown. For some staked locations along the old stock driveway, we have found that total avoidance is not possible.

Final reclamation of old-growth areas, as with other tree stands, after abandonment would not replace the characteristics that were lost. Appropriate vegetation, including ponderosa pine, would be planted in areas formerly occupied by ponderosa pine forest; however, several centuries may pass before these directly impacted areas once again show substantial characteristics of old growth. Other areas that currently support mature ponderosa pine would advance into an old growth condition within a shorter timeframe, but the geographic extent of this structural and ecological representation is based on future management decisions, primarily timber harvest, that may affect ponderosa pine stands within the Project Area.

### 3.8.3.7 Ecological Processes and CBM Development

The alternatives may cause alteration of ecological processes, particularly fire, insects, and disease. Fire regimes may change for several reasons. For example, the frequency of human-caused fire may increase because of the greater amount of activity, especially along roads, in the Project Area. Conversely, the larger road network may increase the ability of local firefighters to suppress fires, reducing the spread of fires in areas where access was previously limited. In addition, fire suppression may increase to protect CBM facilities. The potential for allowing naturally ignited fires to burn would be reduced because of the need to protect CBM facilities. Alternatives with a greater level of development and road construction, such as Alternative 1 and Alternative 2, would affect fire regime to a greater extent than alternatives with a lower level of development, such as Alternatives 3, 4, and 5. Mitigation measures, such as closure of project roads to public use and a requirement that industry personnel follow all agency fire precautions, would reduce the potential for increased human-caused fires.

During the project's construction phase, cut trees and limbs would be present along roads and at well pads and may increase infestations of the *Ips* beetle. By attracting more beetles, the surrounding trees that are not directly affected by construction would be at greater risk of insect attack. Alternatives with a greater level of development, such as Alternative 1 and especially Alternative 2, would generate more wood materials than would alternatives with a lower level of development, such as Alternatives 3, 4, and 5. Mitigation measures designed to ensure timely removal of wood from construction areas would reduce the potential for increased insect populations from CBM development.

### 3.8.3.8 Federally Listed Threatened, Endangered, and Proposed Plant Species

One federally listed plant species may occur in the Project Area and may be affected by CBM development. Table 3–78 presents a summary of the direct, indirect, and cumulative effects of the project on this species, as well as a determination of effects (summarized from Appendix H).

### 3.8.3.9 FS Sensitive Plant Species

Four Forest Service sensitive plant species may occur in the Project Area and may be affected by CBM development. Table 3–79 contains a summary of the direct, indirect, and cumulative effects of the project on these species, as well as determinations of effects. Appendix I discusses these effects and determinations in detail.

### 3.8.3.10 Bureau of Land Management Sensitive Plant Species

Two BLM sensitive plant species may occur in the Project Area and may be affected by the proposed project. These species, the Pagosa skyrocket and Pagosa Springs bladderpod, are also FS sensitive species and were discussed previously in Table 3–79. Appendix K presents these effects and determinations in detail.

**Table 3–78 Federally Listed Threatened, Endangered, and Proposed Plant Species — All Alternatives**

| Species Name | Direct and Indirect Effects | Cumulative Effects | Determination |
|---|---|---|---|
| Knowlton's Cactus | Implementation of any of the alternatives is not likely to have any direct or indirect effect on Knowlton's cactus. Preconstruction surveys would be implemented in areas of suitable habitat that would be disturbed by activities associated with any of the alternatives. In the event that any previously unknown occurrences of Knowlton's cactus are discovered during these surveys, the FWS would be consulted, and the location of the occurrence and an appropriate buffer would be avoided by all ground-disturbing activities. | Implementation of any of the alternatives is not likely to have any cumulative effect on Knowlton's cactus. Undocumented occurrences of this species may have been affected by past CBM development or other ground-disturbing activities because suitable habitats may not have been surveyed. | Implementation of the proposed action, as described above, may affect, but is not likely to adversely affect, Knowlton's cactus, based on discountable effects. This determination is based on the lack of known occurrences of this species in the Project Area, negative results from surveys in the Project Area, and the avoidance of buffer areas surrounding any population of Knowlton's cactus that are found during preconstruction surveys |

## 3.8.4 Cumulative Effects

The cumulative effects analysis area is defined as the Project Area and that portion of the area within the exterior bounds of the Southern Ute Indian Reservation where CBM development has and will continue to occur. The cumulative effects study area therefore encompasses 546,648 acres.

### 3.8.4.1 Vegetation Disturbance and CBM Development

Each of the alternatives would contribute to cumulative vegetation impacts in the Project Area. Table 3–80 through Table 3–86 display cumulative vegetation removal due to existing and proposed oil and gas development. Other activities that would contribute to cumulative vegetation impacts in the Project Area are not quantifiable because of lack of study and associated data. These other factors are addressed qualitatively and include sand and gravel mining, ranching, agriculture, road construction, and rural and urban housing development. The vegetation types that would be most impacted are grasslands, sagebrush, pinyon juniper and ponderosa pine. Future CBM development would remove about 9,000 acres of vegetation in addition to the 16,500 acres already impacted.

## Table 3–79 Forest Service Sensitive Plant Species —All Alternatives

| Species Name | Direct and Indirect Effects | Cumulative Effects | Determination |
|---|---|---|---|
| Aztec Milk-vetch | No known occurrences of this species would be disturbed. 11 to 234 acres (less than 1 to 2 percent) of suitable habitat for this species would be disturbed. Alternative 2 would involve the largest amount of disturbance, followed by Alternatives 1, 1A, 1B, 3, 4, , and 5 in decreasing order. Pre-construction surveys would be implemented in areas of suitable habitat. If any previously unknown occurrences of the Aztec milk-vetch were discovered, the location of the occurrence and an appropriate buffer would be avoided to the extent possible. | Cumulative effects from past and present actions include CBM development, land management activities (timber harvest, livestock grazing and other factors), and recreational use. These same effects are expected to continue in the future within the Project Area and surrounding lands. Each of the alternatives would have minimal cumulative effects on the Aztec milk-vetch. | Implementation of any of the alternatives may adversely impact individuals, but is not likely to result in a loss of viability on the planning area, nor cause a trend toward federal listing or a loss of species viability range wide for the Aztec milk-vetch. This determination is based on the low likelihood that this species occurs within the Project Area, the implementation of pre-construction surveys in suitable habitats that would be disturbed by each of the alternatives, and implementation of avoidance measures if new occurrences are discovered. |
| Giant Helleborine | No known occurrences of this species would be disturbed. No suitable habitat for this species would be disturbed under any of the alternatives. Pre-construction surveys would be implemented in areas of suitable habitat. If any previously unknown occurrences of the giant helleborine were discovered, the location of the occurrence and an appropriate buffer would be avoided to the extent possible. Construction in or near suitable wetland or spring habitats may alter or interrupt the hydrologic conditions that support this species. Groundwater withdrawal associated with the project may result in decreased spring and seep flows in areas that support this species. Increased access would increase opportunities for collection of this species by hobbyists. | Cumulative effects from past and present actions include CBM development, land management activities (timber harvest, livestock grazing, and other factors), and recreational use. These same effects are expected to continue in the future within the Project Area and surrounding lands. Each of the alternatives would have minimal cumulative effects on the giant helleborine. Groundwater withdrawals cause the cumulative reduction of spring and seep flows. | Implementation of any of the alternatives may adversely impact individuals, but is not likely to result in a loss of viability on the planning area, nor cause a trend toward federal listing or a loss of species viability range wide for the giant helleborine. This determination is based on the low likelihood that this species occurs within, or extensively within, the Project Area, the implementation of pre-construction surveys in suitable habitats that would be disturbed by each of the alternatives, and the implementation of avoidance measures if new occurrences are discovered. |
| Pagosa Skyrocket | No known occurrences of this species would be disturbed. From 83 to 941 acres (less than 1 to 2 percent) of suitable habitat for this species would be disturbed. Alternative 2 would involve the largest amount of disturbance, followed by Alternatives 1, 1A, 1B, 4, and 5 in decreasing order. Pre-construction surveys would be implemented in areas of suitable habitat. If any previously unknown occurrences of the Pagosa Skyrocket were discovered, the location of the occurrence and an appropriate buffer would be avoided to the extent possible. | Cumulative effects from past and present actions include CBM development, land management activities (timber harvest, livestock grazing, and other factors), and recreational use. These same effects are expected to continue in the future within the Project Area and surrounding lands. Each of the alternatives would have minimal cumulative effects on the Pagosa skyrocket. | Implementation of any of the alternatives would have no impact on the Pagosa skyrocket on federal jurisdiction. This determination is based on implementation of pre-construction surveys in suitable habitats on federal lands that would be disturbed by each of the alternatives and implementation of avoidance measures if new occurrences are discovered. |
| Pagosa Springs Bladderpod | No known occurrences of this species would be disturbed. 46 to 806 acres (less than 1 to 4 percent) of suitable habitat for this species would be disturbed. Alternative 2 would involve the largest amount of disturbance, followed by Alternatives 1, 1A, 1B, 3, 4, and 5 in decreasing order. Pre-construction surveys would be implemented in areas of suitable habitat. If any previously unknown occurrences of the Pagosa Springs bladderpod were discovered, the location of the occurrence and an appropriate buffer would be avoided to the extent possible. | Cumulative effects from past and present actions include CBM development, land management activities (timber harvest, livestock grazing, and other factors), and recreational use. These same effects are expected to continue in the future within the Project Area and surrounding lands. Each of the alternatives would have minimal cumulative effects on the Pagosa Springs bladderpod. | Implementation of any of the alternatives would have no impact on the Pagosa Springs bladderpod on federal jurisdiction. This determination is based on the low likelihood that this species occurs within the Project Area, the implementation of pre-construction surveys in suitable habitats that would be disturbed by each of the alternatives, and the implementation of avoidance measures if new occurrences are discovered. |

## Table 3–80 Cumulative CBM Impacts to Vegetation — Alternative 1

| | Project Area | | SUIT Study Area | | | |
|---|---|---|---|---|---|---|
| Vegetation Type | Existing Impact (acres) | Future Impact (acres) | Existing Impact (acres) | Future Impact (acres) | Total (acres) | Portion of Vegetation Type (percent) |
| Grasslands | 286 | 63 | 4,155 | 1,192 | 5,696 | 6.3 |
| Sagebrush | 221 | 67 | 3,897 | 1,118 | 5,303 | 6.2 |
| Pinyon-Juniper | 229 | 215 | 5,174 | 3,439 | 9,057 | 5.1 |
| Mountain Shrub | 21 | 10 | 865 | 248 | 1,144 | 6.0 |
| Gambel Oak | 162 | 140 | 204 | 404 | 910 | 3.1 |
| Ponderosa Pine | 310 | 390 | 354 | 710 | 1,764 | 3.4 |
| Mixed Conifer | 9 | 60 | 0 | 0 | 70 | 1.5 |
| Aspen | 8 | 15 | 0 | 0 | 23 | 1.8 |
| Riparian/Wetlands | 11 | 3 | 220 | 272 | 506 | 5.7 |
| Agriculture | 113 | 42 | 0 | 0 | 156 | 1.7 |
| Barren | 117 | 10 | 0 | 0 | 127 | 5.5 |
| Water | 1 | 0 | 0 | 0 | 1 | 0.5 |
| Total | 1,489 | 1,016 | 14,869 | 7,383 | 24,757 | 5.2 |

## Table 3–81 Cumulative CBM Impacts to Vegetation — Alternative 1A

| | Project Area | | SUIT Study Area | | | |
|---|---|---|---|---|---|---|
| Vegetation Type | Existing Impact (acres) | Future Impact (acres) | Existing Impact (acres) | Future Impact (acres) | Total (acres) | Portion of Vegetation Type (percent) |
| Grasslands | 286 | 46 | 4,155 | 1,192 | 5,679 | 6.2 |
| Sagebrush | 221 | 62 | 3,897 | 1,118 | 5,297 | 6.2 |
| Pinyon-Juniper | 229 | 174 | 5,174 | 3,439 | 9,016 | 5.1 |
| Mountain Shrub | 21 | 10 | 865 | 248 | 1,144 | 6.0 |
| Gambel Oak | 162 | 116 | 204 | 404 | 886 | 3.0 |
| Ponderosa Pine | 310 | 340 | 354 | 710 | 1,714 | 3.3 |
| Mixed Conifer | 9 | 48 | 0 | 0 | 57 | 1.3 |
| Aspen | 8 | 15 | 0 | 0 | 23 | 1.7 |
| Riparian/Wetlands | 11 | 3 | 220 | 272 | 506 | 5.7 |
| Agriculture | 113 | 44 | 0 | 0 | 158 | 1.7 |
| Barren | 117 | 11 | 0 | 0 | 128 | 5.5 |
| Water | 1 | 0 | 0 | 0 | 1 | 0.5 |
| Total | 1,489 | 869 | 14,869 | 7,383 | 24,610 | 5.1 |

## Table 3–82 Cumulative CBM Impacts to Vegetation — Alternative 1B

| | Project Area | | SUIT Study Area | | | |
|---|---|---|---|---|---|---|
| Vegetation Type | Existing Impact (acres) | Future Impact (acres) | Existing Impact (acres) | Future Impact (acres) | Total (acres) | Portion of Vegetation Type (percent) |
| Grasslands | 286 | 36 | 4,155 | 1,192 | 5,669 | 6.2 |
| Sagebrush | 221 | 58 | 3,897 | 1,118 | 5,294 | 6.2 |
| Pinyon-Juniper | 229 | 152 | 5,174 | 3,439 | 8,994 | 5.1 |
| Mountain Shrub | 21 | 10 | 865 | 248 | 1,144 | 6.0 |
| Gambel Oak | 162 | 57 | 204 | 404 | 827 | 2.8 |
| Ponderosa Pine | 310 | 239 | 354 | 710 | 1,613 | 3.1 |
| Mixed Conifer | 9 | 13 | 0 | 0 | 23 | 0.5 |
| Aspen | 8 | 13 | 0 | 0 | 21 | 1.6 |
| Riparian/Wetlands | 11 | 3 | 220 | 272 | 506 | 5.7 |
| Agriculture | 113 | 42 | 0 | 0 | 156 | 1.7 |
| Barren | 117 | 11 | 0 | 0 | 129 | 5.6 |
| Water | 1 | 0 | 0 | 0 | 1 | 0.5 |
| Total | 1,489 | 634 | 14,869 | 7,383 | 24,375 | 5.1 |

## Table 3–83 Cumulative CBM Impacts to Vegetation — Alternative 2

| | Project Area | | SUIT Study Area | | | |
|---|---|---|---|---|---|---|
| Vegetation Type | Existing Impact (acres) | Future Impact (acres) | Existing Impact (acres) | Future Impact (acres) | Total (acres) | Portion of Vegetation Type (percent) |
| Grasslands | 286 | 128 | 4,155 | 1,192 | 5,761 | 6.3 |
| Sagebrush | 221 | 94 | 3,897 | 1,118 | 5,330 | 6.2 |
| Pinyon-Juniper | 229 | 361 | 5,174 | 3,439 | 9,204 | 5.2 |
| Mountain Shrub | 21 | 42 | 865 | 248 | 1,176 | 6.2 |
| Gambel Oak | 162 | 325 | 204 | 404 | 1,095 | 3.7 |
| Ponderosa Pine | 310 | 589 | 354 | 710 | 1,963 | 3.8 |
| Mixed Conifer | 9 | 85 | 0 | 0 | 94 | 2.1 |
| Aspen | 8 | 29 | 0 | 0 | 37 | 2.8 |
| Riparian/Wetlands | 11 | 3 | 220 | 272 | 506 | 5.7 |
| Agriculture | 113 | 71 | 0 | 0 | 184 | 2.0 |
| Barren | 117 | 20 | 0 | 0 | 137 | 5.9 |
| Water | 1 | 0 | 0 | 0 | 1 | 0.5 |
| Total | 1,489 | 1,746 | 14,869 | 7,383 | 25,487 | 5.3 |

## Table 3–84 Cumulative CBM Impacts to Vegetation — Alternative 3

| | Project Area | | SUIT Study Area | | | |
|---|---|---|---|---|---|---|
| Vegetation Type | Existing Impact (acres) | Future Impact (acres) | Existing Impact (acres) | Future Impact (acres) | Total (acres) | Portion of Vegetation Type (percent) |
| Grasslands | 286 | 59 | 4,155 | 1,192 | 5,692 | 6.2 |
| Sagebrush | 221 | 67 | 3,897 | 1,118 | 5,303 | 6.2 |
| Pinyon-Juniper | 229 | 168 | 5,174 | 3,439 | 9,010 | 5.1 |
| Mountain Shrub | 21 | 10 | 865 | 248 | 1,144 | 6.0 |
| Gambel Oak | 162 | 63 | 204 | 404 | 833 | 2.8 |
| Ponderosa Pine | 310 | 258 | 354 | 710 | 1,632 | 3.2 |
| Mixed Conifer | 9 | 20 | 0 | 0 | 30 | 0.6 |
| Aspen | 8 | 0 | 0 | 0 | 8 | 0.6 |
| Riparian/Wetlands | 11 | 3 | 220 | 272 | 506 | 5.7 |
| Agriculture | 113 | 42 | 0 | 0 | 156 | 1.7 |
| Barren | 117 | 7 | 0 | 0 | 124 | 5.4 |
| Water | 1 | 0 | 0 | 0 | 1 | 0.5 |
| Total | 1,489 | 696 | 14,869 | 7,383 | 24,438 | 5.1 |

## Table 3–85 Cumulative CBM Impacts to Vegetation — Alternative 4

| | Project Area | | SUIT Study Areas | | | |
|---|---|---|---|---|---|---|
| Vegetation Type | Existing Impact (acres) | Future Impact (acres) | Existing Impact (acres) | Future Impact (acres) | Total (acres) | Portion of Vegetation Type (percent) |
| Grasslands | 286 | 50 | 4,155 | 1,192 | 5,683 | 6.2 |
| Sagebrush | 221 | 49 | 3,897 | 1,118 | 5,284 | 6.2 |
| Pinyon-Juniper | 229 | 197 | 5,174 | 3,439 | 9,040 | 5.1 |
| Mountain Shrub | 21 | 11 | 865 | 248 | 1,145 | 6.0 |
| Gambel Oak | 162 | 95 | 204 | 404 | 865 | 2.9 |
| Ponderosa Pine | 310 | 213 | 354 | 710 | 1,587 | 3.1 |
| Mixed Conifer | 9 | 38 | 0 | 0 | 47 | 1.0 |
| Aspen | 8 | 2 | 0 | 0 | 10 | 0.7 |
| Riparian/Wetlands | 11 | 3 | 220 | 272 | 506 | 5.7 |
| Agriculture | 113 | 44 | 0 | 0 | 158 | 1.7 |
| Barren | 117 | 8 | 0 | 0 | 125 | 5.4 |
| Water | 1 | 0 | 0 | 0 | 1 | 0.5 |
| Total | 1,489 | 710 | 14,869 | 7,383 | 24,451 | 5.1 |

**Table 3–86 Cumulative CBM Impacts to Vegetation — Alternative 5**

| | Project Area | | SUIT Study Areas | | | Portion of Vegetation |
|---|---|---|---|---|---|---|
| Vegetation Type | Existing Impact (acres) | Future Impact (acres) | Existing Impact (acres) | Future Impact (acres) | Total (acres) | Type (percent) |
| Grasslands | 286 | 21 | 4,155 | 1,192 | 5,654 | 6.2 |
| Sagebrush | 221 | 55 | 3,897 | 1,118 | 5,291 | 6.2 |
| Pinyon-Juniper | 229 | 94 | 5,174 | 3,439 | 8,937 | 5.0 |
| Mountain Shrub | 21 | 5 | 865 | 248 | 1,139 | 6.0 |
| Gambel Oak | 162 | 30 | 204 | 404 | 799 | 2.7 |
| Ponderosa Pine | 310 | 105 | 354 | 710 | 1,479 | 2.9 |
| Mixed Conifer | 9 | 3 | 0 | 0 | 12 | 0.3 |
| Aspen | 8 | 0 | 0 | 0 | 8 | 0.6 |
| Riparian/Wetlands | 11 | 3 | 220 | 272 | 506 | 5.7 |
| Agriculture | 113 | 39 | 0 | 0 | 153 | 1.6 |
| Barren | 117 | 7 | 0 | 0 | 124 | 5.3 |
| Water | 1 | 0 | 0 | 0 | 1 | 0.5 |
| Total | 1,489 | 362 | 14,869 | 7,383 | 24,103 | 5.0 |

## 3.8.4.2 Habitat Structural Stages

Each of the alternatives would contribute to cumulative effects to HSSs in the cumulative effects analysis area. Project activities that remove vegetation, as discussed above, would also remove HSSs and reset the process of ecological succession. Table 3–87 through Table 3–93 display cumulative removal of HSSs by alternative. Other activities that contribute to cumulative effects to HSSs including sand and gravel mining, ranching, agriculture, road construction, and rural and urban housing development are not quantified because of a lack of data regarding their impacts. Effects to HSSs from these activities would be in addition to the cumulative effects that have been quantified.

**Table 3–87 Cumulative CBM Impacts to Habitat Structural Stages — Alternative 1**

| | Loss of Habitat Structural Stages (percent) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0.0 | 6.3 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.3 |
| Sagebrush | 0.0 | 0.0 | 0.0 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.2 |
| Pinyon-Juniper | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.1 | 5.1 | 0.0 | 5.1 | 5.1 | 0.0 | 0.0 | 5.1 |
| Mountain Shrub | 0.0 | 0.0 | 0.0 | 6.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.0 |
| Gambel Oak | 0.0 | 0.0 | 0.0 | 3.1 | 3.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.1 |
| Ponderosa Pine | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 2.9 | 2.4 | 3.3 | 3.5 | 2.5 | 4.7 | 3.4 |
| Mixed Conifer | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.2 | 2.1 | 1.6 | 2.2 | 0.0 | 1.5 |
| Aspen | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 3.2 | 1.1 | 0.3 | 1.6 | 0.0 | 0.0 | 1.8 |
| Riparian | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 5.7 |
| Agriculture | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 |
| Barren | 5.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.5 |
| Water | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 |
| Total | 2.4 | 6.3 | 6.2 | 5.5 | 3.1 | 5.0 | 5.0 | 1.2 | 4.5 | 4.1 | 2.2 | 4.7 | 5.2 |

## Table 3–88 Cumulative CBM Impacts to Habitat Structural Stages — Alternative 1A

| | Loss of Habitat Structural Stages (percent) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0.0 | 6.3 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.2 |
| Sagebrush | 0.0 | 0.0 | 0.0 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.2 |
| Pinyon-Juniper | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.1 | 5.1 | 0.0 | 5.1 | 5.1 | 0.0 | 0.0 | 5.1 |
| Mountain Shrub | 0.0 | 0.0 | 0.0 | 6.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.0 |
| Gambel Oak | 0.0 | 0.0 | 0.0 | 3.0 | 3.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 |
| Ponderosa Pine | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 3.0 | 2.4 | 3.2 | 3.4 | 2.5 | 4.4 | 3.3 |
| Mixed Conifer | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.2 | 1.3 | 1.2 | 2.3 | 0.0 | 1.3 |
| Aspen | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 3.2 | 1.1 | 0.3 | 1.5 | 0.0 | 0.0 | 1.8 |
| Riparian | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 5.7 |
| Agriculture | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 |
| Barren | 5.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.5 |
| Water | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 |
| Total | 2.4 | 6.3 | 6.2 | 5.5 | 3.1 | 5.0 | 5.0 | 1.2 | 4.4 | 4.1 | 2.3 | 4.4 | 5.1 |

## Table 3–89 Cumulative CBM Impacts to Habitat Structural Stages — Alternative 1B

| | Loss of Habitat Structural Stages (percent) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0.0 | 6.2 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.2 |
| Sagebrush | 0.0 | 0.0 | 0.0 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.2 |
| Pinyon-Juniper | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.1 | 5.1 | 0.0 | 5.1 | 5.1 | 0.0 | 0.0 | 5.1 |
| Mountain Shrub | 0.0 | 0.0 | 0.0 | 6.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.0 |
| Gambel Oak | 0.0 | 0.0 | 0.0 | 2.8 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.8 |
| Ponderosa Pine | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.1 | 2.9 | 2.3 | 3.0 | 3.2 | 2.3 | 3.6 | 3.1 |
| Mixed Conifer | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.2 | 0.5 | 0.6 | 0.0 | 0.0 | 0.5 |
| Aspen | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 3.1 | 0.0 | 0.3 | 1.2 | 0.0 | 0.0 | 1.6 |
| Riparian | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 5.7 |
| Agriculture | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 |
| Barren | 5.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.6 |
| Water | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 |
| Total | 2.4 | 6.2 | 6.2 | 5.4 | 3.0 | 5.0 | 5.0 | 1.0 | 4.3 | 3.9 | 0.5 | 3.6 | 5.1 |

## Table 3–90 Cumulative CBM Impacts to Habitat Structural Stages — Alternative 2

| | Loss of Habitat Structural Stages (percent) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0.0 | 6.4 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.3 |
| Sagebrush | 0.0 | 0.0 | 0.0 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.2 |
| Pinyon-Juniper | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.2 | 5.2 | 0.0 | 5.2 | 5.2 | 0.0 | 0.0 | 5.2 |
| Mountain Shrub | 0.0 | 0.0 | 0.0 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.2 |
| Gambel Oak | 0.0 | 0.0 | 0.0 | 3.7 | 4.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.7 |
| Ponderosa Pine | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.2 | 3.3 | 2.5 | 3.8 | 3.8 | 2.6 | 4.8 | 3.8 |
| Mixed Conifer | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 1.5 | 0.4 | 5.3 | 1.8 | 2.3 | 0.0 | 2.1 |
| Aspen | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.6 | 3.4 | 1.3 | 4.1 | 1.8 | 0.2 | 0.0 | 2.8 |
| Riparian | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 5.7 |
| Agriculture | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 |
| Barren | 5.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.9 |
| Water | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 |
| Total | 2.7 | 6.4 | 6.2 | 5.7 | 4.2 | 5.2 | 5.1 | 1.3 | 4.7 | 4.3 | 2.3 | 4.8 | 5.3 |

## Table 3–91 Cumulative CBM Impacts to Habitat Structural Stages — Alternative 3

| | Loss of Habitat Structural Stages (percent) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0.0 | 6.3 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.3 |
| Sagebrush | 0.0 | 0.0 | 0.0 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.2 |
| Pinyon-Juniper | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.1 | 5.1 | 0.0 | 5.1 | 5.1 | 0.0 | 0.0 | 5.1 |
| Mountain Shrub | 0.0 | 0.0 | 0.0 | 6.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.0 |
| Gambel Oak | 0.0 | 0.0 | 0.0 | 2.8 | 3.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.8 |
| Ponderosa Pine | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 2.9 | 2.4 | 3.0 | 3.3 | 2.5 | 3.5 | 3.2 |
| Mixed Conifer | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 1.0 | 0.8 | 0.0 | 0.0 | 0.6 |
| Aspen | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.9 | 0.0 | 0.3 | 0.3 | 0.0 | 0.0 | 0.6 |
| Riparian | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 5.7 |
| Agriculture | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 |
| Barren | 5.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.4 |
| Water | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 |
| Total | 2.4 | 6.3 | 6.2 | 5.4 | 3.1 | 5.0 | 5.0 | 0.9 | 4.3 | 4.0 | 0.6 | 3.5 | 5.1 |

## Table 3–92 Cumulative CBM Impacts to Habitat Structural Stages — Alternative 4

| | Loss of Habitat Structural Stages (percent) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0.0 | 6.3 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.2 |
| Sagebrush | 0.0 | 0.0 | 0.0 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.2 |
| Pinyon-Juniper | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.1 | 5.1 | 0.0 | 5.1 | 5.1 | 0.0 | 0.0 | 5.1 |
| Mountain Shrub | 0.0 | 0.0 | 0.0 | 6.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.0 |
| Gambel Oak | 0.0 | 0.0 | 0.0 | 2.9 | 3.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.9 |
| Ponderosa Pine | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.7 | 2.9 | 2.4 | 3.0 | 3.2 | 2.5 | 3.6 | 3.1 |
| Mixed Conifer | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.9 | 0.0 | 2.3 | 1.0 | 0.9 | 0.0 | 1.0 |
| Aspen | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 0.9 | 1.1 | 0.3 | 0.3 | 0.0 | 0.0 | 0.8 |
| Riparian | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 5.7 |
| Agriculture | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 |
| Barren | 5.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.4 |
| Water | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 |
| Total | 2.4 | 6.3 | 6.2 | 5.5 | 3.6 | 5.1 | 5.0 | 1.0 | 4.3 | 3.9 | 1.2 | 3.6 | 5.1 |

## Table 3–93 Cumulative CBM Impacts to Habitat Structural Stages — Alternative 5

| | Loss of Habitat Structural Stages (percent) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type | n/a | 1M | 1T | 2S | 2T | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Total |
| Grasslands | 0.0 | 6.2 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.2 |
| Sagebrush | 0.0 | 0.0 | 0.0 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.2 |
| Pinyon-Juniper | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.0 | 5.0 | 0.0 | 5.0 | 5.1 | 0.0 | 0.0 | 5.0 |
| Mountain Shrub | 0.0 | 0.0 | 0.0 | 6.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.0 |
| Gambel Oak | 0.0 | 0.0 | 0.0 | 2.7 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.7 |
| Ponderosa Pine | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 2.8 | 2.4 | 2.8 | 3.0 | 2.4 | 2.8 | 2.9 |
| Mixed Conifer | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.3 | 0.3 | 0.0 | 0.0 | 0.3 |
| Aspen | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.9 | 0.0 | 0.3 | 0.3 | 0.0 | 0.0 | 0.6 |
| Riparian | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 5.7 |
| Agriculture | 1.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 |
| Barren | 5.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.3 |
| Water | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 |
| Total | 2.3 | 6.2 | 6.2 | 5.4 | 3.0 | 5.0 | 4.9 | 0.9 | 4.2 | 3.8 | 0.5 | 2.8 | 5.0 |

Areas reclaimed after CBM development would differ substantially from undisturbed areas in terms of HSS. The short-term cumulative impact would consist of a loss of later seral stages (4A, 4B, and 4C) and an increase in early and mid-seral stages (1M, 2S, 3A, 3B, and 3C).

### 3.8.4.3 Wetlands, Riparian Areas and CBM Development

Much of the discussion of cumulative effects to vegetation and HSSs is also relevant to wetlands and riparian areas. Sand and gravel mining, ranching, agriculture, road construction, and rural and urban housing development have likely impacted wetlands and riparian areas via habitat loss or degradation, road development, and degradation of water quality. These types of activities are expected to increase in number and frequency within the Project Area, commensurate with the growth in regional population. The COE permitting process is designed in part to minimize the cumulative effects of filling wetlands; therefore, minimal direct loss of wetlands from this and other projects is expected in the future. Cumulative degradation of wetlands and riparian areas by sediment would be minimized through the use of BMPs and mitigation measures developed on site during the APD evaluation process.

### 3.8.4.4 Vegetation Restoration and CBM Development

Interim and permanent vegetation restoration would occur in areas of existing and proposed CBM development. These activities are conducted to ensure that CBM-related disturbances are temporary and do not cause permanent loss of vegetation and productivity in the Project Area. Still, many other disturbances that occur in the Project Area are not subject to similar restoration requirements and have greater potential to cause permanent loss of vegetation, introduction of noxious weeds, and loss of vegetative productivity.

### 3.8.4.5 Noxious Weeds and CBM Development

The cumulative effect of noxious weed infestations in the Project Area has not been quantified; however, agriculture and residential development have all played a substantial role in the introduction and spread of noxious weeds. Agricultural and residential uses are widespread in the cumulative effects analysis area and are not subject to the same strict weed control measures as is oil and gas development. CBM development would be subject to mitigation measures for weed control, minimizing any cumulative impacts of noxious weeds on vegetation in the Project Area. On-going agricultural and residential land uses would continue to be the primary causes for introduction and spread of noxious weeds throughout the Project and cumulative effects area.

### 3.8.4.6 Old-Growth Ponderosa Pine and CBM Development

The cumulative loss of old-growth stands to CBM development on NFS lands in the Project Area is only slightly higher than the Project effects shown on Table 3–77. Ten acres of field-verified old growth were lost to the construction of NFSR 615, one well pad, and a short-segment of unnumbered road accessing this well pad in the past. Although only a small loss of old growth can be quantified, a much larger amount has been lost over the past century to timber harvest and wildland fire. Of the 34,693 acres of ponderosa pine stands in the Project Area, a larger proportion probably was in old-growth (late seral) structural stage before Euro-American settlement and development of the Project Area..

Similar patterns in loss of old-growth ponderosa pine forests are seen across the entire SJNF. Of the 260,941 acres of ponderosa pine stands on the SJNF, 15,020 acres (5.8 percent) are currently in an old-growth stage (FS and BLM 2003). A large proportion of the old-growth ponderosa pine has been harvested, mostly with partial cuts that removed the largest trees form the affected stand, or lost due to wildland fire. Since 1990, 314 acres of old-growth ponderosa pine have been harvested on the SJNF, and 332 acres were burned during the Missionary Ridge Fire in 2002 (FS and BLM 2003).

There has been a general reduction in the extent of these old-growth ponderosa pine stands. More recently, most remaining old-growth stands have been protected. The extent of stands of old-growth ponderosa pine should increase in the future. Old-growth ponderosa pine stands totaling 1,081 acres are within the analysis areas of future timber sales on the SJNF (FS and BLM 2003), although it is expected that few, if any, of these stands will actually be harvested. Approximately 364 acres of old-growth pine fall within the boundaries of existing oil and gas leases on the western side of the SJNF outside of the Project Area. No data are available for the eastern side of the SJNF (FS and BLM 2003). Oil and gas development may or may not occur within these stands in the future.

### 3.8.4.7 Ecological Processes and CBM Development

The incremental effects of CBM development on ecological processes, such as fire and insect and disease infestations, are primarily cumulative because of the long period and widespread, landscape scale of these processes. Natural fire regimes have been, and will continue to be, altered. CBM development would likely result in increased firefighting effort across the Project Area to protect facilities and further alter natural fire regimes. Future fire regimes are more likely to be dictated by the extent of residential development on private lands, the continuing accumulation of unnaturally high fuels loads in many vegetation types, and long-term weather trends, such as drought. Likewise, insect and disease infestations across the landscape would be more affected by activities beyond the scope of the current project than by project activities. Current and future droughts will be the primary cause of *Ips* beetle outbreaks. Mitigation measures would be used to reduce the potential for the proposed project to affect beetle outbreaks.

### 3.8.4.8 Federally Listed Threatened, Endangered, and Proposed Plant Species, FS Sensitive Plant Species, and BLM Sensitive Plant Species.

The cumulative effects to federally listed threatened, endangered, and proposed plant species are presented in Table 3–78. The cumulative effects to FS and BLM sensitive plant species are presented in Table 3–79.

## 3.8.5 Mitigation and Monitoring

Unless otherwise stated, the following measures will be funded by the Companies.

- Minimize disturbance to vegetation by clearing and otherwise disturbing vegetation within the smallest area needed for safe and efficient development, production, and maintenance.
- Avoid old-growth ponderosa pine stands wherever possible, and minimize impacts to individual large, old trees when avoidance is not possible.
- Protect snags and down-dead logs to the extent possible. Snags and logs outside of disturbance areas should be removed only when they pose a hazard to the human life and property.
- Locate well pads, compressors, and other non-linear facilities outside of riparian areas, wetlands, and floodplains to the extent practical to protect these features.
- Avoid crossings of wetlands and riparian areas by linear features such as pipeline, roads, and power lines to the extent practicable. Where crossings cannot be avoided, impacts should be minimized through use of the following measures:
    - All crossings of wetlands and other waters of the U.S. should comply with USACE regulations (for example, Nationwide Permits 12 and 14). If potential effects exceed the limits of the nationwide permits, individual permits should be obtained.
    - All use of nationwide and other USACE permits should be documented. Where notification of the USACE is not required by permit conditions, the Companies should submit documentation of compliance with nationwide permits to the USACE annually.
    - Develop site-specific mitigation plans during the APD, POD, or Sundry Notice approval process for all proposed disturbance to wetlands and riparian areas.
    - Apply all applicable standards from FS Handbook 2509.25, the Watershed Conservation Practices Handbook (FS 2001c), on NFS lands. In particular, 12.1 Standard (3) should be applied: “In the water influence zone next to perennial and intermittent streams, lakes, and wetlands, allow only those actions that maintain or improve long-term stream health and riparian ecosystem condition.”
    - Construct crossings perpendicular to wetlands and riparian areas.
    - Disturb wetland and riparian areas only during dry conditions (that is, during late summer or fall), or when the ground is frozen during the winter.
    - Do not deposit waste material below high-water lines in riparian areas, floodplains, or natural drainage ways.
    - Locate the lower edge of soil or other material stockpiles outside the active floodplain.
    - Locate drilling mud pits outside of riparian areas, wetlands, and floodplains.

- Reshape disturbed channels to their original configuration and ensure they are properly stabilized.
- Begin reclamation of disturbed wetlands and riparian areas immediately after project activities are complete.
- If production is established, interim reclamation of unused portions of the well pad should begin as soon as feasible. If the well is not productive, the entire well site should be reclaimed.
- Reclaim the reserve pit and that portion of the location and access road not needed for access and production facilities. Drill cuttings should be placed in a trench and buried when operations end. Stockpiled topsoil should be spread evenly over the disturbed area. Enough topsoil should be retained to reclaim the remainder of the location at abandonment. This remaining stockpile of topsoil should be seeded in place using the prescribed seed mixture.
- Broadcast seed between September 1 and December 1 or at other times with prior approval of the Authorized Officer.
- Use certified, weed-free seed. The preference is for local, native seed. Where local, native seed is not available, non-local native and non-native seed may be used, subject to prior approval of the Authorized Officer. Certification tags that are removed from seed mixtures should be provided to the Authorized Officer.
- Specify seed mixes during the APD and POD approval process. In addition to seeding, shrubs and trees that were present before construction should be replaced during reclamation. Shrubs may be seeded; live trees should be planted in previously forested areas.
- It is recommended that the seed mixture be applied with a drill. If the seed is broadcast, some means such as a harrow should be used to incorporate the seed into the soil.
- Certified weed-free mulch may be required on locations with an inadequate supply of removed vegetation for use as mulch.
- The entire well pad should be fenced and a gate or cattle guard provided where the well access road crosses the fence. The fence should be built within 7 days after initial well drilling is completed. The fence should be maintained until the areas that are not needed for production are revegetated.
- Begin final reclamation on all disturbed areas as soon as feasible after the site it abandoned. The same methods used for interim reclamation apply to final reclamation. Gravel surfacing, if used, should be removed from the well pad and disposed of at an approved site. The well site should be contoured to pre-construction conditions. Stored topsoil should be spread over the entire disturbed area. All areas of soil disturbed by operations should be scarified to at least a 4-inch depth and drainage structures should be installed at specified locations.
- Continue reclamation efforts until all areas are successfully revegetated and accepted. Reclamation should be considered successful when the desired vegetative species are established, erosion is controlled,

weeds are considered a minimal threat, and it is likely that ground cover will return to a desirable condition.

- Companies submit a noxious weed control plan as a component of the APD and POD approval process. Components of this plan should include:
  - The operator is responsible for the treating and eliminating any noxious weeds that may be introduced and established on disturbed areas. This responsibility remains until the disturbed areas are successfully reclaimed and accepted.
  - Complete an inventory of noxious weeds at each site before disturbance. Treat any infestations of noxious weeds before disturbance begins to reduce the risk of spread during construction.
  - Pressure-wash heavy equipment before it enters public lands and when it moves between areas on public lands.
  - Monitor all disturbed areas for noxious weeds for a minimum of 3 years after interim and final reclamation.
  - Treat all noxious weed infestations for a minimum of 5 years after they are detected.
  - Treat all noxious weeds by methods to be approved by the Authorized Officer. These methods may include biological, mechanical, or chemical treatments. Should chemical or biological treatment be requested, the operator must submit a Pesticide Use Proposal to the Authorized Officer 60 days before the planned application date.
  - Minimize the creation of fuel concentrations by chipping, piling, and burning, or removing from the site any woody debris from construction.
- To the extent practical, the operator should take measures to prevent uncontrolled fires on the area of operation and to suppress uncontrolled fires resulting from operations. All fires should be reported to the FS/BLM immediately after they are detected.
- When trees (including pinyon pine, juniper, ponderosa pine, and Douglas-fir) are cleared for construction of oil and gas facilities during periods of insect activity (April through October), all cut material should be disposed of within 3 weeks to prevent this material from attracting or harboring insects. At other times of the year, removal of cut material would not be required within 3 weeks, however it should be removed at least 3 weeks before April 1, the expected date that insects emerge in spring. Acceptable disposal methods include burying material on site, chipping and removing chips from the Project Area, or removing material from the Project Area without chipping. Smaller materials would be removed under certain conditions. Materials less than 4 inches in diameter does not have to be removed if scattered in a thin layer so that they dry thoroughly within a 3-week period. If materials are stacked or piled such that they do not dry quickly, only materials less than 2 inches in diameter may remain on site.
- If deemed necessary by the agencies, trees should be protected from infestation by bark beetles through preventative spraying of selected trees.

Preventive spraying is a proven method of repelling bark beetle infestation and can reduce future hazards to public safety posed by unstable, dying trees. Spray pesticides can include Carbaryl (commonly known as Sevin) or Permethrin (commonly known as Astro) on the trunks and branches of selected trees. These treatments would: (1) follow manufacturer's safety recommendations for certified applicators; (2) take place only during dry weather conditions to avoid water contamination; and (3) take place only when wind speeds are low to reduce drift. Sites should be closed to the public during spraying and until the pesticide dries completely, probably only for a few days. Signs should be posted to alert the public as to the trees that have been sprayed.

- Conduct pre-construction surveys for Knowlton's cactus, Aztec milkvetch, giant helleborine, Pagosa skyrocket, and Pagosa Springs bladderpod in all potential disturbance areas that are identified as suitable habitat during the pre-construction phase of the project. At a minimum, the entire occupied area should be avoided by all ground-disturbing activities

## 3.8.6 Conformance to Existing Plans and Policies

### 3.8.6.1 BLM Lands

The San Juan/San Miguel Planning Area RMP (BLM 1985), and the Decision Record for the Standards for Public Land Health (Standards) and Guidelines for Livestock Grazing Management (BLM 1997) contain the following resource objectives and standards. These resource objectives and standards apply only to BLM lands. The resource objectives and standards discussed below may be affected by the proposed project. Other resource objectives and standards that are related to vegetation are not included here because they would not be affected by the proposed project.

#### *Resource Objectives*

No activities will be permitted in habitat for threatened, endangered, or sensitive species that would jeopardize their continued existence (RMP, page 12).

#### *Standards*

**Standard 2**: Riparian systems associated with both running and standing water function properly and have the ability to recover from major disturbance such as fire, severe grazing, or 100-year floods. Riparian vegetation captures sediment and provides forage, habitat, and biodiversity. Water quality is improved or maintained. Stable soils store and release water slowly (Standards, page 6).

**Standard 3:** Healthy, productive plant and animal communities of native and other desirable species are maintained at viable population levels commensurate with the species and habitat's potential. Plants and animals at both the community and population level are productive, resilient, diverse, vigorous, and able to reproduce and sustain natural fluctuations and ecological processes (Standards, page 7).

**Standard 4:** Special status, threatened, and endangered species (federal and state), other plants and animals officially designated by the BLM, and their habitats are maintained or enhanced by sustaining healthy, native plant and animal communities (Standards, page 7).

### *Conformance with Resource Objectives and Standards*

As documented in the Biological Assessment (Appendix H) and BLM Sensitive Species assessment (Appendix K), the proposed project would not jeopardize the continued existence of any threatened, endangered, or sensitive plant species under any of the seven alternatives. Although there may be minimal effects to some species, viable populations of special status and other plant species and their habitats are likely to be maintained in the Project Area. Mitigation measures would help to ensure that adverse effects to special status and other species are minimized.

The preceding sections discuss the potential effects of the project's alternatives on vegetation. Although negative impacts are predicted for each alternative, the extent of these effects is low in relation to the amount of each plant community that exists in the Project Area. Productive, resilient, diverse, vigorous, and sustainable plant communities would be maintained throughout implementation of the project. These communities would be replaced to the extent practicable after the project is complete.

Mitigation measures that promote avoidance of riparian and wetland areas have been incorporated into each of the alternatives. Implementation of these measures would ensure that riparian systems continue to function properly.

## 3.8.6.2 NFS Lands

The LRMP for the SJNF (FS 1992) contains the following direction and guidelines. The guidelines discussed below may be affected by the proposed project. Other guidelines that address vegetation management are not included here because they would not be affected by the proposed project.

### *Management Activity: Diversity on National Forests and National Grasslands*

**Forest Direction**

General Direction

Maintain structural diversity of vegetation on units of land 5,000 to 20,000 acres in size, or 4th-order watersheds that are dominated by forested ecosystems (LRMP page III–11).

In forested diversity units, maintain at a minimum on each treated area, an average of 20 to 30 snags (in all stages of development) per 10 acres, well distributed over the diversity unit (LRMP page III–11).

Guidelines

In forested areas of a unit, 5 percent or more should be in old growth and 5 percent or more should be in grass/forb stages (LRMP page III–11).

Provide at a minimum and average of 6 to 10 snags per 10 acres of the following minimum diameters (where biologically feasible): ponderosa pine, Douglas-fir, and spruce-fir: 10 inches DBH; aspen and lodgepole pine: 8 inches DBH (LRMP page III–11).

Retain an average length per acre of down-dead logs (where biologically feasible) of the following minimum diameters: ponderosa pine, Douglas fir, and spruce-fir: 12 inches diameter and 50 linear feet/acre; aspen and lodgepole pine: 10 inches diameter and 33 linear feet/acre (LRMP page III–12).

### *Conformance with Guidelines*

Current data show that 6.5 percent of the NFS lands in the Project Area are in the grass/forb seral stage. Of the forested areas on NFS lands in the Project Area (the diversity unit for this analysis), between 2.3 and 3.1 percent is old growth. The lower percentage assumes that a large portion of the gambel oak type is potential ponderosa pine, and aspen is also included in the percentage calculation. Of the ponderosa pine that now exists within the national forest portion of the Project Area, 3.8 percent has been identified as old growth. This figure may be slightly lower than the actual old-growth representation, because not all known pockets of old growth have been mapped to date, nor has the entire Project Area been comprehensively inventoried through onsite investigation. Nevertheless, the structural diversity of the project area is such that the guideline is currently being met for the grass/forb seral stage, but not for old growth.

The amount of grasslands would be reduced slightly, to between 6.2 and 6.4 percent of NFS lands in the Project Area, depending on the selected alternative. The minimum 5-percent grass/forb guideline would continue to be met.

The alternatives would impact 36 acres of old growth pine, or less. Consequently, old growth would be reduced to between 2.2 and 3.1 percent of forested areas on NFS lands in the Project Area, or between 3.6 and 3.8 percent of ponderosa pine stands on NFS lands in the Project Area, depending on the alternative selected. Therefore, it would take longer for this landscape to achieve the 5-percent old-growth standard through continued maturation of un-impacted stands. There is also concern that the impact to old growth extends beyond the physical area impacted within any given stand. Although we can't quantify the extent of such impact, we would take steps during well and road siting to reduce these potential impacts.

Through field observation, it is believed that the guidelines for snags and down-dead logs are not being met on in ponderosa pine stands within the Project Area. Firewood cutters have long accessed the area. Data on snags and down-dead logs from old-growth stands indicate that these areas are stands where S&Gs are being met, as would be expected in old-growth stands. Because these are the oldest stands and have never been commercially harvested, they tend to have more snags and down-dead wood than are found in other areas. All snags and down-dead logs would be removed on well pads, along roads, and at other facility sites. Mitigation measures are recommended to protect these important habitat features to the greatest extent possible during project implementation.

## 3.8.7 Unavoidable Adverse Effects

Unavoidable adverse effects are adverse effects that would occur because of the proposed project, despite implementation of mitigation measures designed to minimize adverse effects. Vegetation, including habitat structural stages, would be impacted or removed. Small amounts of wetlands and riparian areas would be impacted or removed. Portions of old-growth stands of ponderosa pine would be removed. Infestations of noxious weeds would increase and displace native vegetation. Fire regimes would be altered. Potential habitats for special status plant species would be lost.

## 3.8.8 Irreversible and Irretrievable Commitments of Resources

### 3.8.8.1 Irreversible Commitments

Loss of old-growth stands of ponderosa pine beyond the life of the project would be an irreversible commitment because restoring functional old-growth stands would be an extremely long-term process.

### 3.8.8.2 Irretrievable Commitments

Irretrievable commitments would include: loss of vegetative cover until reclamation is successful, loss of late-serial habitat structural stages beyond the life of the project, loss of some riparian and wetland vegetation over the life of the project, loss of potential habitats for special status plant species, and decreased productivity of native plant communities because of increased infestations of noxious weeds.

# 3.9 Wildlife

This section presents a summary of wildlife environmental consequences from several resource reports that collectively address the potential effects of the alternatives on wildlife and fisheries resources in the Project Area. The complete analyses are presented in the following resource reports: the Biological Assessment (Appendix H), Biological Evaluation (Appendix I), Management Indicator Species (MIS) Analysis (Appendix J), BLM Sensitive Species analysis (Appendix K), and State of Colorado Threatened and Endangered Species analysis (Appendix L).

## 3.9.1 Issues

*Issue 6: The effects of additional CBM development on wildlife and fisheries and their habitats.*

- Will increased CBM development result in increased wildlife harassment, road-kill, hunting pressure, and wildlife displacement?
- What are the impacts of additional CBM development on important game species?
- How will CBM development affect the suitability of wildlife habitat? Will development cause a loss of high-value and critical big game winter ranges, habitat loss, habitat fragmentation, and disruption of migration routes?
- Will CBM development affect the long-term viability of wildlife populations?
- How will downstream fisheries be affected as a result of dewatering of the Fruitland coal? Will groundwater and surface water quality and quantity change, and how will that affect fisheries?

*Issue 16: The effects of additional CBM development on Federal and State listed threatened, endangered, proposed, candidate, and sensitive animal species and their habitats.*

## 3.9.2 Regional Characterization

The Project Area is located at the interface of the Colorado Plateau physiographic province and the Southern Rocky Mountains physiographic province (Mutel and Emerick 1992). The location of the Project Area at this interface makes it valuable to many species of wildlife. Wildlife species and habitat elements common to both of these physiographic provinces are found in the Project Area. Species that utilize the higher, moister, conifer-dominated habitats of the Rocky Mountains are found in the eastern third of the Project Area. Species more typical of the warmer, drier Colorado Plateau occur in the western two-thirds of the Project Area. Migratory species, such as big game and many bird species, move back and forth across the Project Area with the seasons.

## 3.9.3 General Wildlife Mitigation Measures

In addition to Forest Plan standards and guidelines, the following mitigation measures are recommended to reduce or minimize effects of CBM development and production on wildlife and their habitats. Mitigation measures specific to individual wildlife species are listed in later sub-sections. Unless otherwise stated, the following measures will be funded by the Companies.

- Minimize the number and length of new access roads. This measure reduces direct habitat loss and loss of habitat effectiveness.
- Where possible, construct access roads to new wells as spurs from the existing road system rather than as separate primary access roads. This measure reduces direct habitat loss and loss of habitat effectiveness.
- Prohibit employees and contractors from bringing dogs or carrying firearms on site. This mitigation reinforces standard working agreements with industry and is applied to reduce wildlife harassment.
- Continue to implement periodic employee and contractor wildlife-awareness programs, covering seasonal wildlife requirements and sensitivities, how disturbances affect wildlife, and ways personnel can reduce disturbances. Experience has shown that these forums promote effective industry participation in implementing and enforcing mitigation measures.
- Install mufflers or screens on exhaust systems or open pipes, to avoid wildlife entrapment and mortality.
- Avoid construction within riparian and wooded riparian areas. This measure reduces critical habitat loss and potential for stream sedimentation.
- Inventory for and restrict new well locations and rights-of-way to at least ¼ mile from a raptor nest or winter roost. This measure is demonstrated to reduce human-wildlife conflicts that can lead to nest abandonment and/or area avoidance.
- Inventory for and prohibit construction or other intrusive activities within 0.5 miles of an active raptor nest during nesting season between January 1 and July 1.
- Minimize the number of well-monitoring trips, by coordinating well visits to limit traffic or installing automated monitoring systems. This measure reduces human/wildlife conflicts and loss of habitat effectiveness.
- No activities other than routine well activities (activities that are conducted in the course of maintaining production operations at a well site such as daily site visits, minor repairs on surface equipment or removal of produced water by truck) shall take place from December 1 to April 30, unless approved by the Authorized Officer. Operations of this type outside of this period will be evaluated upon written request to the FS or BLM for such consideration. This measure reduces human/wildlife conflicts and loss of habitat effectiveness during the critical winter season.

- Take measures to exclude and protect wildlife species from drilling fluids. These measures include, but are not limited to: fence and place solid or mesh covers over reserve pits. Properly designed covers have been shown to be effective and are commonly used throughout the industry for these purposes.

- Gate all newly created access roads and require all industry personnel passing through locked gates to close and re-lock each gate immediately upon passage. Road closures reduce the risk of mortality, displacement, and impacts to wildlife habitat effectiveness.

- Permanently close all roads that are not designated as open in the travel management plan, not used by industry to access CBM sites, and not used for administrative purposes. Measures will be taken to effectively close such roads. Measures include, but are not limited to: block roads at least one site distance up the roadbed by placement of large boulders, livestock gates, or earthen barriers interspersed with tree trunks and branches, or obliterated and recontoured back to the original slope. This mitigation would offset the impact of new roads. In most cases, this mitigation has been effective in deterring public motorized traffic, thereby reducing wildlife displacement, mortality, and loss of habitat effectiveness.

- Upon road decommissioning, obliterate roads, re-contour back to original slope and re-vegetated with an appropriate seed mix (this could include seedlings and/or saplings). This measure, in concert with road closures, and off-road travel restrictions would somewhat restore pre-project conditions and improve habitat effectiveness for wildlife.

- Restrict well access roads not designated as open to the public to authorized CBM operations only. Also prohibit CBM employee use of recreational off road vehicles unless such equipment is necessary for job performance. This mitigation reinforces standard working agreements with industry. It is believed this mitigation would be effective maintaining habitat capability and reducing wildlife mortality and dispersal.

- Require all trash be transported off-site daily or stored in bear proof containers (McCllelan and Shackleton 1988). This requirement applies to all compressor sites, well pads and other infrastructure sites during the construction phase. No overnight storage of wildlife attractant materials shall be permitted at any infrastructure sites during the production phase. This mitigation would effectively reduce habituation by wildlife to human food sources.

- To the extent practicable, use noise reduction technologies at all infrastructure sites during construction and production phases. It is believed this mitigation would be effective in reducing wildlife displacement that may occur from areas immediately adjacent to infrastructure facilities (Harding and Nagy 1980).

- No activities other than routine well activities (activities that are conducted in the course of maintaining production operations at a well site such as daily site visits, minor repairs on surface equipment or removal of produced water by truck) shall take place within big game winter ranges from December 1 to April 30, unless approved by the Authorized Officer.

- Schedule routine maintenance activities to occur between 0900 to 1500 hours at facilities in big game winter ranges during critical seasons and at facilities that must be accessed by roads through sensitive habitat.

- Remove all chemicals from project sites to avoid exposure to wildlife. This would allow wildlife to forage in developed areas without risk of exposure to harmful chemicals.

- Re-seed unused portions of roads and well pads as quickly as possible after disturbance with native grass, shrub, and forb seed mixtures to encourage faster re-growth of native nesting and foraging habitat in disturbed areas. Reseeding immediately after disturbance has been shown to significantly reduce the time for re-establishment of vegetation on disturbed sites, thereby restoring wildlife forage and hiding cover more quickly than solely natural reseeding.

- Restrict the use of open reserve pits during drilling unless absolutely necessary. Where possible, capture all liquid in containers and dispose of in an approved manner. Where reserve pits are necessary during drilling, cover all pits with mesh or other covers that prevent bird and mammal entry. If reserve pits are necessary, properly designed covers have been shown to be effective in excluding wildlife and are commonly used by industry for this purpose. Conduct spot checks to assure proper designs are used.

- All mitigation measures described in Section 3.9.10.4 (*Mitigation and Monitoring*), Section 3.6 (*Surface Water Resources*), and Section 3.7 (*Soils*) intended to reduce sediment inputs to surface waters are applicable to aquatic habitat and fisheries. No additional measures are recommended for brown trout.

- Add additional, site-specific mitigation measures to protect wildlife and their habitats to individual APDs and SUPOs as conditions of approval as conditions warrant.

## 3.9.4 General Wildlife Environmental Consequences

Wildlife habitats directly affected by development of new well pads, roads, etc., represent a small proportion of all habitats present. However, construction and operation disturbances emanating from these areas reduce habitat effectiveness for wildlife in a larger surrounding area. These disturbance areas vary in width depending on a number of factors including intervening terrain and vegetation, the type and duration of disturbance, the species of wildlife present, and the time of year. Elk and deer are the wildlife species that would be most affected by development under all alternatives. Adverse affects are primarily associated with disturbance on, and displacement from, winter ranges.

Impacts to wildlife would be greatest onsite and primarily related to human disturbance and habitat loss. Construction impacts resulting in initial habitat loss would extend over approximately five years for all alternatives. Operational impacts and disturbances resulting from potentially increased public access would be the most significant wildlife related impact associated with the project. These indirect impacts would be far greater from a wildlife perspective than the relatively small acreages of habitats directly lost to roads and well pads. Operational impacts resulting in disturbances to wildlife on important seasonal ranges would be long term, unless mitigation such as road closures and utilization of remote well monitoring telemetry are utilized. These steps could effectively limit traffic to one well visit per week, maintaining habitat integrity. Offsite impacts, related to disturbance of wildlife on seasonal ranges, such as highway mortality, habitat loss, and game damage to private property, should be minor relative to on-site impacts. General summaries for each of these impact types are presented below.

### 3.9.4.1.1 Direct Habitat Loss

Road, well pad, and other facility construction would result in direct loss of wildlife habitat under each alternative. Habitat loss would reduce available forage and habitat components in the affected area. Habitats next to those directly disturbed may be degraded by changes in vegetation, including the invasion of noxious weeds.

The direct loss of habitat is a function of the number of wells, roads, and other facilities constructed under each of the alternatives. Alternative 2 would result in the largest habitat loss, 1,670 acres, followed in descending order by Alternatives 1, 1A, 4, 3, 1A and 5 (316 acres). Certain habitat types would be affected more than others but, overall, there would not be a direct loss of habitat in excess of 2 percent for any species across the Project Area as a result of new CBM development.

Most of the habitat impact would be on national forest in the HD Mountains, because it is currently the least developed and would experience the most new development. The west side of the Project Area is extensively developed as agricultural and residential land and has experienced the most CBM development to date. Future CBM development on the west side of the Project Area would add a small increment of direct habitat loss to the landscape. To partially offset this impact, unused portions of well sites would be restored during the production phase. At the end of the production phase, all facilities would be removed and disturbed areas restored.

The time period that impacted land would be unsuitable as wildlife habitat is variable and would depend on well lifespan, restoration techniques and success, and local weather. But generally, restoration of habitats dominated by grasses and forbs should be successful within several years. Where the goal is to restore habitats dominated by shrubs and trees, regrowth of young stands to those mature structural stages may take decades or more. Consequently, the disturbance of forest and shrub habitats would represent a long-term impact beyond the end of the production phase to those species that depend on such vegetation for forage or shelter. A small portion of the roads constructed for gas field development would not be reclaimed, but would be maintained as part of the permanent road system, resulting in permanent loss of wildlife habitats. Conversely, some existing roads in the National Forest portion of the Project Area have been removed from the permanent road system and will revert to suitable habitat conditions over time.

### 3.9.4.1.2 Habitat Effectiveness

The scientific literature supports quantitative analysis of habitat effectiveness impacts for elk and mule deer. For other wildlife species, surrounding habitat that which is directly disturbed would be reduced in habitat effectiveness, but the extent of that area is not well known or defined by scientific study.

Wildlife may avoid increased human activity, equipment operation, vehicular traffic, and noise associated with all phases of each alternative and prefer other locations. This avoidance would result in the under-utilization of otherwise suitable habitats; therefore, the effectiveness of these habitats in supporting wildlife would be diminished. Similarly, the displacement of wildlife from disturbed areas may lead to the overuse of suitable habitats in undisturbed areas, increasing competition for limited resources. Wildlife distribution patterns would be altered. The degree of habitat avoidance would vary between species and among individuals of any particular species. Development would not occur in a manner that affects only certain, isolated parts of the Project Area at a particular time. For this reason, no attempt has been made to predict temporal patterns of loss of habitat by affected wildlife. Alternative 2 would cause the greatest loss of habitat effectiveness, and thus capacity to support wildlife, followed in descending order by Alternatives 1, 1A, 4, 3, 1B, and 5.

Within the broad category of habitat effectiveness, several factors can be measured and discussed individually. These include road density, hunting pressure/ harassment, and displacement. Each of these factors is analyzed below.

#### Road Density

Road-density increases would be the greatest for alternatives with more proposed wells, and would be less for alternatives where fewer wells are proposed. The greatest relative increases in road density would occur primarily on NFS land for Alternatives 1, 1A, 1B, 2, 3, and 4, because development would be focused on land that has low current density. Alternative 5 would result in minor road development on NFS land; thus, the increase in road density would be distributed across private and state ownerships relatively evenly.

Road density is related to habitat effectiveness and is a good measure for estimating indirect effects on big game (Rowland et al. 2000). Project-induced increases in road density on NFS land, and potential for human-wildlife conflict, would be greatest in Alternative 2, followed in descending order by Alternatives 1, 1A, 4, 3, 1B, and 5.

#### Hunting Pressure/Harassment

Between 33 and 177 miles of new road would be constructed under the alternatives. These roads would provide increased access to public land in the Project Area as a whole; potentially leading to both increased legal-hunting pressure and poaching. Private landowners would continue to control hunting on, split-estate and private lands. Alternatives where more new roads would be constructed on public land, such as Alternatives 1, 1A, 2, and 4, would result in a greater increase in hunting pressure and harassment of game species than alternatives with fewer new roads on public land, such as Alternatives 1B, 3, and 5. Public road closures would partially mitigate this impact, but the expanded road system would be open to foot and horseback traffic, making travel throughout large portions of the project area easier than currently experienced. The existing road and trail system is open to ATVs.

#### *Displacement*

Displacement during the construction phase may alter patterns of habitat use and movements for individual animals, but would result in only minimal, overall disruptions of seasonal habitat use or movement for entire herds because of the large areas occupied by these herds and the scattered nature of anticipated development. Displacement during the production phase would result in only minimal alteration of habitat use and movement patterns for both individual animals and entire herds, because of habituation to regular low-grade disturbance (Yarmoloy et al. 1988). Nevertheless, the additive effect of displacement events on big game could be detrimental to individual-animal health or condition, particularly in areas of concentrated development.

### *3.9.4.1.3 Vehicle Collisions*

Increased vehicle traffic is expected during all phases of the project under each alternative. The potential for vehicle collisions with wildlife species is directly correlated to the volume of traffic. Project-related traffic volume would be greatest during the construction phase and diminish during the production and abandonment phases.

Most project roads would be designed for slower speeds and not likely to cause any substantial increase in vehicle collisions. Most collisions occur on county roads and highways, where speeds are greater and where the vast majority of traffic is not CBM-related. Nevertheless, an increase in CBM traffic would occur on these roads, as well, and a minimal increase in vehicle collisions may occur. The increase in traffic would be directly correlated with the number of new wells; therefore, alternatives with a higher number of wells, such as Alternatives 1 and 2, have a greater potential to increase vehicle collisions than alternatives with a lower number of wells.

### *3.9.4.1.4 Habitat Fragmentation*

Construction and operation of project-related facilities would result in the fragmentation of wildlife habitats in the Project Area and on NFS land. Fragmentation would occur through loss of narrow strips along roads and small patches at well pad and facility sites. The extent of this fragmentation is substantially different than the type of fragmentation that has been studied extensively in other areas: habitat loss would occur as narrow strips and small patches within a largely unaffected matrix, as opposed to widespread habitat loss with a few, small remaining patches of unaffected habitat.

The effects of habitat fragmentation would vary by wildlife species. For some, such as those that are small and less mobile (e.g., rodents, reptiles, and amphibians) fragmentation may disrupt movement and reduce connectivity between individuals or populations. For other species, such as those that readily cross the relatively narrow CBM access roads (e.g., bear and mountain lion), the type and extent of fragmentation anticipated with this project would be minor.

Agriculture and rural development have caused extensive fragmentation of habitats in the western two-thirds of the Project Area, and minor fragmentation in parts of the eastern third. The fragmentation anticipated to result from each of the alternatives would increase the cumulative amount of habitat fragmentation in the Project Area minimally because of the pattern of fragmentation anticipated and the relatively small amounts of habitats that would be affected.

#### *3.9.4.1.5 Duration of Impacts*

While adverse impacts associated with gas development may be moderate and long-term, they should not be permanent. In 30 years or less, all gas well and the vast majority of access roads would be removed and the areas reclaimed. The year round operational activities associated with the gas facilities would cease and wildlife would return to former use patterns. As the gas field develops, use of technologies that accelerate gas recovery, could be used to compress the time-frames that wildlife are potentially affected by gas development.

## 3.9.5 Important Game Species

The impact of CBM development to game species was an issue of widespread concern in scoping. Game species of concern include black bear and Merriam's wild turkey, in addition to elk and deer, which are analyzed in Section 3.9.6 and Appendix J.

### 3.9.5.1 Black bear

More than 80 percent of the Project Area comprises black bear fall range. Based on CDOW range delineation, the Project Area makes up the middle of the largest fall range bear habitat in La Plata and Archuleta Counties. The Project Area also provides the largest block of bear fall habitat on the SJNF, having a large component of both mountain shrublands and piñon juniper (FS no date). Both of these vegetation types are important food sources for bears.

Black bear populations are limited by several factors. Periodic starvation caused by spring/fall food shortages is probably the most important one. Populations can also be limited by the age structure of the female population. Other natural factors include predation, injuries from other bears, disease, and cannibalism of cubs by young males. The most pronounced limiting factor, however, is human-caused mortality (FS, no date). Types of human actions that can limit the black bear population include "damage control" operations for apiary and livestock operators, killing of nuisance bears in housing developments located in fall range, poaching, the timing and method of black bear hunting season, and excessive harvesting during the hunting season. Indirect effects on bears can also occur from activities that change important feeding areas, such as fuelwood cutting and chaining in Gambel oak, and home building in fall range habitats (FS, no date).

CBM development activities that have the greatest influence on these controlling factors are: direct loss of habitat — mostly gamble oak habitat where mast production is an important component of bear habitat; change in human access to the area, which may in turn influence hunter success and poaching; and construction and production activities, which, in turn, can cause bear harassment and displacement from portions of important habitat.

In terms of direct habitat impact, a relatively minor amount of bear habitat would be lost for the short and long term under all alternatives. Within the Project Area, the alternative most unfavorable to bear habitat would be Alternative 2, resulting in the loss of 1,052 acres, which is 2.4 percent of bear habitat in the Project Area. Alternative 2 would be followed in descending order by Alternatives 1, 1A, 4, 3, 1B, and 5, in terms of direct impact on bear habitat. Because the direct loss of bear habitat is relatively small, compared with the total amount of bear habitat in the Project Area, individual bears are not likely to be adversely affected by direct habitat loss, and thus the effects of direct habitat loss under all alternatives would be minor.

Roads increase vehicular and human access and increase hunter success, poaching, the probability of vehicle-bear collisions, and the frequency of energy-costly flight responses by bears avoiding disturbances. Poaching has been found to be one of the greatest impacts on bear populations associated with new road development (McClellan and Shackleton 1988, Brody and Pelton 1989). Poaching has been found to be a limiting factor for bears and, in more than one study, has accounted for at least 20 percent of known bear mortalities (Beck 1991, FS, no date). It has been suggested that for every bear taken legally, another is killed illegally (Gill and Beck 1990). Both legal hunting and poaching could increase, but road closures would restrict travel throughout most of the HD Mountains to foot and horseback, thus moderating this impact and conceivably even reducing hunter success and poaching. Both mortality factors are not thought to be extensive enough to cause a decline in bears in the Project Area.

The potential for displacement of bears would most likely be highest during the construction phase of the project, when human activity would be greatest. Fall-range displacement is of particular concern. The alternatives would involve road construction in fall bear range, increasing the likelihood of displacement of bears from optimal feeding areas. The greater the road and well pad impact on fall range, the greater the impact on bears. Alternative 2 would have the greatest potential to displace bears from other wise suitable habitat, followed in descending order by Alternatives, 1, 4, 1A, 1B, 3 and 5. Overall, feeding patterns would be altered, but the alteration most likely would not impact bear reproduction.

Noise levels would be most extensive during the construction phase, decreasing during the production phase. Bear may become habituated to daily or once weekly vehicles on gated roads, or they may continue to be sensitive to human disturbance and flee the areas immediately adjacent to roads. Nevertheless, the frequency of industry traffic would be low enough that noise/traffic displacement should be low to moderate during the production phase. Unless attracted by human garbage, bears would most likely avoid compressor sites during construction and production phases, due to the level of disturbance at these sites. Noise may affect individual bears but the magnitude of impact would be moderate.

### 3.9.5.2 Merriam's Turkey

Nesting habitat and mast production are two main limiting factors that affect Merriam's turkey (Wait 2002). Weather and disease are also limiting factors. The alternatives may affect nesting habitat and mast production but would have no effect on the other limiting factors.

Within the Project Area, Alternative 2 would most extensively effect turkey habitat, followed in descending order by Alternatives 1, 1A, 4, 3, 1B, and 5. Overall, turkey habitat is not currently limiting in the Project Area nor would it be after alternative implementation. In light of direct habitat loss, the magnitude of effects across all alternatives is expected to be moderate affecting only individuals.

Roost trees are a critical habitat component; turkeys congregate to them, and the flock reuses them over time (Wait 2002). Without roost trees, otherwise suitable habitats are useless (Hoffman 1993). Loss of roost trees would negatively affect turkey under all alternatives. On the SJNF, there are approximately 9,872 acres of potential roost tree habitat. Elsewhere in the Project Area, there is approximately 14,628 acres of potential roosting habitat. Alternatives do not vary significantly in the acres of roost tree habitat impacted. Between 66 and 465 acres of roosting habitat on National Forest land would be impacted by the alternatives. This acreage represents a loss of approximately 3 percent of potential roost tree habitat for any of the alternatives. Alternative 2 impacts the greatest amount of roost habitat, followed in descending order by Alternatives 1, 1A, 3, 4, 1B, and 5. Protection measures are recommended below to help reduce these impacts.

Oak brush is less limiting in the Project Area than are roost trees. Since oak brush is not limiting in the Project Area, and the majority of the turkey habitat would not be impacted, a maximum 1.5-percent overall loss of this habitat should not measurably impact turkey under any of the alternatives.

The construction of project facilities, roads, and utility corridors would slightly increase the degree of fragmentation of habitats within the Project Area. Under each of the alternatives, habitat fragmentation would not be substantial; construction areas would not create insular habitats because the small openings and narrow breaks do not form barriers to turkey movement and dispersal. Alternative 2 would be the most extensive and Alternative 5 the least. For all alternatives, the magnitude of habitat fragmentation impact is minor.

Under all alternatives, increased activity during the construction phase would occur during the turkey-nesting period. Project activities that affect nesting habitats may disturb or destroy unidentified nests. Fledged turkey and adults would avoid injury by fleeing from disturbance, but eggs within nests would be destroyed. Effects on nests and nesting activity would decrease during the production phase, when disturbance is for a short time period on the road prism, near well pads and at compressor stations and turkey would tend to avoid these activities when selecting nest sites.

During the Project's production phase, turkey winter ranges would most likely experience one vehicle per day of short duration disturbance, or one vehicle per week where remote monitoring telemetry is utilized. This would most likely cause avoidance of roads and some habitat (likely less than 250 meters) on the winter range for the short-term. Enforcement of effective road closures would reduce turkey impacts. If roost trees are avoided, it is suspected that during the production phase turkey would habituate to the traffic during the winter. Turkey roost trees are able to sustain some degree of disturbance. For example, turkeys roost within ¼ mile of an open county road in the Project Area (Wait 2002).

Hunting could moderately increase in the Project Area due to the increase in road access into remote turkey habitat. Overall, recreation impacts on turkey are not likely to be severe: impacts on turkey are more tied to impacts on ponderosa pine habitat, and turkey seem to tolerate some degree of disturbance at roost sites (Wait 2002, FS, no date). The magnitude of impact is expected to be moderate for all alternatives.

### 3.9.5.3 Mitigation and Monitoring

Unless otherwise stated, the following measures will be funded by the Companies.

**Black Bear**

- If an active black bear den is discovered adjacent to a new road, well pad, or other infrastructure, stop construction activities and notify the Authorized Officer. This mitigation would effectively protect the bear and its den from harm.

- To the extent practical, avoid facility construction on or adjacent to large diameter (greater than 3 inches) gambel oak stands. These oak stands are the primary producers of acorns, a key autumn food source for bear. This mitigation would be effective in minimizing loss of gambel oak stands in most cases. There are well spacing limits consistent with the existing regulations and terrain features that may reduce the ability in some cases to avoid construction in large diameter gambel oak.

**Turkey**

- Avoid destruction of known active roost trees by surveying potential habitat prior to heavy equipment removing vegetation. Survey areas within 200 meters of proposed construction activities. Buffer known roost trees from removal by about 150 feet surrounding the outer most trees if possible (Wait 2002). All trees within roost sites should be protected, regardless of size. This measure would effectively protect turkey roost trees.

- To the extent practical, avoid construction on or adjacent to roosting habitat. Preferred sites have the following characteristics: on slopes sheltered from the wind with easterly aspects, within ½ mile of water, and with a minimum of ground cover. Large trees with open branches and open crowns are optimal, especially if they are ponderosa pine trees. This measure would effectively minimize roost habitat impact in most cases. There are well spacing requirements that may reduce the ability in some cases to avoid construction in roost tree habitat.

- To the degree possible, retain large diameter gambel oak clumps that are greater than 3 inches in diameter. These trees provide acorns for turkey. There are limits on how far a well may be moved consistent with the existing spacing orders that may reduce the ability in some cases to avoid construction in large diameter gambel oak.

- Eliminate roads from meadows and openings wherever possible. This criterion is most important in turkey winter range areas and along Ignacio Creek. This measure would be effective in minimizing effects of habitat loss in most cases. There are distance limits consistent with the existing well spacing orders that may reduce the ability in some cases to avoid construction in meadows and openings.

- Within turkey winter range, when conducting partial or permanent site rehabilitation, consider using a species mix that includes native species comprised of 50 percent large seeded grasses and 50 percent forbs, of which 20 percent should be legumes. It is believed this mitigation would be effective for providing feeding habitat in the long term for turkeys. Inspect seeding revegetation success and replant as necessary and as climatic conditions permit.

## 3.9.6 Management Indicator Species

MIS are those species selected to function as a "bellwether" for other species that have the same habitat needs or similar population characteristics, and whose population generally can be quantitatively ascertained and/or monitored. Species selected as MIS are selected because their population changes are believed to indicate the effects of management activities (36 CFR 219.19 (a) (1). For the purpose of assessing the effects of the alternatives on wildlife populations, the FS has designated MIS. Seven wildlife species have been selected as MIS for the proposed project. An analysis of each of these species is presented in Appendix J. The following discussion of baseline information, concerns, effects of CBM development to date, and effects of the alternatives is summarized from the MIS analysis (Appendix J) and other appendices as referenced.

### 3.9.6.1 Affected Environment

The MIS addressed in this analysis include Abert's squirrel, brown trout, elk, green-tailed towhee, hairy woodpecker, mountain bluebird, and mule deer. The MIS represent larger groups of species that are grouped into three categories: early-, mid-, and late-successional species. Early successional species, such as mountain bluebird, pocket gophers, and voles, are associated with the early stages of vegetation development (dominated by grass, forbs, shrubs, and tree seedlings) where suitable cover is available. Mid-successional species, such as green-tailed towhee and warbling vireo, thrive in young (dominated by pole-sized trees), healthy forest environments. Late successional species, such as Abert's squirrel, hairy woodpecker, and flammulated owl thrive in mature and late successional forests where they find adequate food and cover. Many species, such as blue grouse, Steller's jay, mule deer, and elk, are associated with a variety of habitats and successional stages for food and cover, and are considered habitat generalists.

The quantity and quality of habitats for MIS were estimated by evaluating habitat structural stage (HSS) matrices as described by Towry (1984) and by using professional judgment based on field reconnaissance. Table 3–94 shows the acreage and proportion of suitable habitats for each MIS species on all lands in the Project Area.

**Table 3–94 Extent and Proportion of the Project Area that Provides Habitats for MIS**

| Species | Preferred Habitats | Habitats in Project Area (acres) | Portion of Project Area (percent) |
|---|---|---|---|
| Abert's squirrel | Mid- and late-successional ponderosa pine habitat. | 33,055 | 26 |
| Brown trout | All rivers and creeks within the Project Area may contain suitable habitat including the Piedra, Pine, Animas, and Florida Rivers. | NA | <1 |
| Elk | All early, mid, and late-successional habitats. The Project Area provides important winter range. | 113,501 | 91 |
| Green-tailed towhee | Early- and mid-successional habitats, in sagebrush, Gambel oak, and mountain shrub. | 58,559 | 47 |
| Hairy woodpecker | Mid- and late-successional ponderosa pine, aspen, and mixed conifer with large snags for cavity nesting. | 45,207 | 36 |
| Mountain bluebird | Early, mid, and late-successional habitats including sagebrush, mountain shrub, Gambel oak, pinyon-juniper, riparian, aspen, and ponderosa pine. Dependent on snags for cavity nesting. May also nest in green trees if a suitable cavity is available. | 98,652 | 79 |
| Mule deer | All early, mid, and late-successional habitats. Project Area provides important winter range. | 113,501 | 91 |

## 3.9.6.2 Environmental Consequences

MIS can be impacted by loss of habitat, loss of habitat effectiveness (through impacts such as increased road density, hunting pressure/harassment, and displacement), vehicle collisions, and habitat fragmentation, and by the cumulative effects of the proposed project and other past, present, and reasonably foreseeable activities. Each of these potential impacts is evaluated in detail in the individual MIS sections of Appendix J.

### *3.9.6.2.1 Direct Habitat Loss*

Direct loss of MIS habitat would occur under each alternative during the construction phase of the project, as a result of road, well pad, and other facility construction. Habitat loss would reduce available forage and habitat components in the affected area. Habitats next to those directly disturbed may be degraded by changes in vegetation, including the invasion of noxious weeds.

The direct loss of MIS habitat is a function of the number of wells, roads, and other facilities constructed under each of the alternatives. Alternative 2 would cause the largest habitat loss, followed in descending order by Alternatives 1, 1A, 4, 3, 1A, and 5. Certain habitat types would be affected more than others (Table 3–95) but, overall, there would not be a direct loss of habitat in excess of 2 percent for any species across the Project Area as a result of new CBM development (Table 3–96).

**Table 3–95 Amount of MIS Habitats Available and Affected by each Alternative for each MIS in the Project Area**

| Species | Habitats Available (acres) | Habitats Affected by Alternative (acres) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Abert's squirrel | 33,055 | 373 | 332 | 228 | 565 | 244 | 212 | 101 |
| Brown trout | NA | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Elk | 113,501 | 967 | 814 | 581 | 1,671 | 644 | 654 | 316 |
| Green-tailed towhee | 58,559 | 433 | 361 | 278 | 817 | 293 | 338 | 177 |
| Hairy woodpecker | 45,207 | 492 | 428 | 291 | 769 | 311 | 296 | 132 |
| Mountain bluebird | 98,652 | 829 | 671 | 476 | 1,460 | 553 | 548 | 263 |
| Mule deer | 113,501 | 967 | 814 | 581 | 1,671 | 644 | 654 | 316 |

Most of the new habitat impact would be on national forest in the HD Mountains, because it is currently the least developed and would experience the most new development. The west side of the Project Area is extensively developed as agricultural and residential land and has experienced the most CBM development to date. Future CBM development on the west side of the Project Area would add a small increment of direct habitat loss to the landscape. To partially offset this impact, unused portions of well sites would be restored during the production phase. At the end of the production phase, all facilities would be removed and disturbed areas restored.

**Table 3–96 Proportion of MIS Habitats Available and Affected by each Alternative for each in the Project Area**

| Species | Habitats Available (percent) | Habitats Affected by Alternative (percent) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Abert's squirrel | 26 | 1 | 1 | >1 | 2 | >1 | >1 | >1 |
| Brown trout | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Elk | 91 | >1 | >1 | >1 | 2 | >1 | >1 | >1 |
| Green-tailed towhee | 47 | >1 | >1 | >1 | 1 | >1 | >1 | >1 |
| Hairy woodpecker | 36 | 1 | >1 | >1 | 2 | >1 | >1 | >1 |
| Mountain bluebird | 79 | >1 | >1 | >1 | 2 | >1 | >1 | >1 |
| Mule deer | 91 | >1 | >1 | >1 | 2 | >1 | >1 | >1 |

The time period that impacted land would be unsuitable as wildlife habitat is variable and would depend on well lifespan, restoration techniques and success, and local weather. But generally, restoration of habitats dominated by grasses and forbs should be successful within several years. Where the goal is to restore habitats dominated by shrubs and trees, regrowth of young stands to those mature structural stages may take decades or more. Consequently, the disturbance of forest and shrub habitats would represent a long-term impact beyond the end of the production phase to those species that depend on such vegetation for forage or shelter. A small portion of the roads constructed for gas field development would not be reclaimed, but would be maintained as part of the permanent road system, resulting in permanent loss of wildlife habitats. Conversely, some existing roads in the National Forest portion of the Project Area have been removed from the permanent road system and will revert to suitable habitat conditions over time.

### 3.9.6.2.2 Habitat Effectiveness

The scientific literature supports quantitative analysis of habitat effectiveness impacts for elk and mule deer. For the Abert's squirrel, green-tailed towhee, hairy woodpecker, and mountain bluebird, surrounding habitat that is directly disturbed would be reduced in habitat effectiveness, but the extent of that area is not well known or defined by scientific study.

In response to increased human activity, equipment operation, vehicular traffic, and noise associated with all phases of each alternative, wildlife may avoid these activities and prefer other locations. This avoidance would result in the under-utilization of otherwise suitable habitats; therefore, the effectiveness of these habitats in supporting wildlife would be diminished. Similarly, the displacement of wildlife from disturbed areas may lead to the overuse of suitable habitats in undisturbed areas, increasing competition for limited resources. Wildlife distribution patterns would be altered. The degree of habitat avoidance would vary between species and among individuals of any particular species. Development would not occur in a manner that affects only certain, isolated parts of the Project Area at a particular time. For this reason, no attempt has been made to predict temporal patterns of loss of habitat by affected wildlife. Alternative 2 would cause the greatest loss of habitat effectiveness, and thus capacity to support MIS, followed in descending order by Alternatives 1, 1A, 4, 3, 1B, and 5.

### 3.9.6.2.3 Habitat Trend

Each alternative would result in a slight loss of habitat for most species. The amount of habitat for each MIS that is available and that would be impacted in the Project Area under each alternative is shown in Table 3–95. The proportion of habitat that is suitable for each MIS, and the proportion of suitable habitats that would be lost on NFS land in the Project Area under each alternative, are shown in Table 3–96.

The MIS analysis also concerns habitat trend over the SJNF and the relationship of project-level impacts to overall Forest trends for MIS species. Table 3–97 describes the Forest-wide habitat trend for the selected MIS (FS, no date). The project would not contribute appreciably to a change in this habitat trend.

**Table 3–97 MIS Habitat Trends**

| MIS | Current Trend | Future Trend |
|---|---|---|
| Abert's squirrel | stable | Same |
| Brown trout | Stable | Same |
| Elk | stable | Same |
| Green-tailed towhee | Slight upward | Same |
| Hairy woodpecker | Slight upward | Same |
| Mountain bluebird | Stable | Same |
| Mule deer | Stable | Same |

#### 3.9.6.2.4 Population Trend

Not being threatened, endangered, or sensitive wildlife species, MIS populations are considered well distributed across the region, the SJNF, and the Project Area. Reduced population is generally a concern if a substantial proportion of available habitats is lost or reduced in effectiveness for a long period. Substantial losses of habitat are not predicted for any of the alternatives on NFS land, or in the Project Area (Table 3–95). On private lands, there may be reduced population levels in the Project Area's west side, where residential development has accelerated over the past decade.

Population trend for each MIS has been analyzed both quantitatively and qualitatively to account for other limiting factors that may affect MIS populations. This analysis follows the conceptual framework presented by Ruggiero et al. (1994), using knowledge of a species' ecology to examine the effects of management actions on the species' habitats and population biology. The outcome is an informed judgment of the effects of the management action on population trend in the analysis area (Ruggiero et al. 1994). Conclusions, based on the SJNF forest-wide MIS assessment, the results of this project assessment (Appendix J), and professional judgment, are shown in Table 3–98.

**Table 3–98 MIS Population Trends**

| MIS | Current Trend | Future Trend |
|---|---|---|
| Abert's squirrel | Stable or slightly decreasing | Stable or slightly decreasing |
| Brown trout | Stable | Stable |
| Elk | Decreasing (per management actions) | Decreasing to Stable |
| Green-tailed towhee | Stable or slightly increasing | Stable or slightly increasing |
| Hairy woodpecker | Stable or slightly decreasing | Stable or slightly decreasing |
| Mountain bluebird | Stable or slightly increasing | Stable or slightly increasing |
| Mule deer | Stable (but variable) | Stable (but variable) |

### 3.9.6.3 Cumulative Effects

The cumulative effects analysis area is defined as the Project Area (125,348 acres) and that area within the bounds of the Southern Ute Indian Reservation that has and will continue to experience oil and gas development (421,300 acres). The Southern Ute Reservation CBM development was recently studied in an EIS completed in October 2002 (BLM et al. 2002). The findings of that EIS are incorporated in the wildlife cumulative effects analysis. The cumulative effects analysis area is, therefore, 546,648 acres. The quantitative analysis is limited to oil and gas development, which is quantified for the entire cumulative effects analysis area. Other activities that would affect MIS such as residential development are assessed qualitatively because of lack of quantitative studies of these components of impact. Additional background information and details on cumulative effects are discussed in the MIS analysis (Appendix J).

**Table 3–99 Extent of Direct Cumulative Loss of MIS Habitats from Oil and Gas Development in Cumulative Effects Analysis Area**

| MIS | Habitats Available (acres) | Habitats Affected by Alternative (acres) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Abert's squirrel | 49,228 | 1,425 | 1,316 | 1,265 | 1,575 | 1,259 | 1,208 | 1,111 |
| Elk | 468,431 | 24,473 | 24,323 | 24,090 | 25,165 | 24,157 | 24,167 | 23,825 |
| Green-tailed towhee | 30,678 | 670 | 506 | 490 | 892 | 502 | 532 | 349 |
| Hairy woodpecker | 122,250 | 4,469 | 4,383 | 4,305 | 4,699 | 4,201 | 4,209 | 4,161 |
| Mountain bluebird | 144,891 | 4,189 | 4,036 | 3,956 | 4,381 | 4,005 | 3,990 | 3,833 |
| Mule deer | 468,430 | 20,085 | 19,996 | 19,771 | 20,706 | 19,838 | 19,831 | |

**Table 3–100 Proportion of Cumulative Loss of MIS Habitats from Oil and Gas Development in Cumulative Effects Analysis Area**

| MIS | Habitats Available (percent) | Habitats Affected by Alternative (percent) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Abert's squirrel | 9 | 2 | 3 | 3 | 3 | 3 | 3 | 2 |
| Elk | 86 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Green-tailed towhee | 6 | 2 | 2 | 2 | 3 | 2 | 2 | 1 |
| Hairy woodpecker | 22 | 4 | 4 | 4 | 4 | 3 | 3 | 3 |
| Mountain bluebird | 26 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Mule deer | 86 | 4 | 4 | 4 | 4 | 4 | 4 | |

Within the cumulative effects area, no more than 5-percent of suitable habitat for any MIS would be directly affected by CBM development. CBM development should impact individuals but not impact forest-wide population trends of MIS (Appendix J). Of greater concern is the loss of habitat effectiveness and displacement that would occur as a result of continued residential and CBM development within the Project's west side. Residential development will be more pervasive in its effect, whereas CBM roads and faculties would be closes and gated to reduce wildlife-human conflict. Big game would be the species most affected by continued residential development (Appendix J).

## 3.9.6.4 Mitigation and Monitoring

The following mitigation measures are recommended, in addition to general mitigation measures presented in Section 3.9.3, for individual MIS species and the wildlife they represent. Unless otherwise stated, the following measures will be funded by the Companies.

### Abert's Squirrel

- Conduct pre-construction surveys to determine presence of squirrel nesting habitat. Minimize impacts to squirrel nesting habitat to the extent practical in consideration of other wildlife species. This is expected to maintain nesting-habitat components effectively for the squirrel within the analysis and standards and guidelines found in Forest Plan direction.

### Elk and Deer

- Where possible, select non-critical and lower use wildlife habitats over critical, important, and high use habitats. One possible means is to use directional drilling methods.
- Restrict disruptive human activity to fifty percent of any calving and fawning area during May, June and July of any given year.
- Minimize fencing, but where necessary install fencing that reduces wildlife mortality and movement while meeting other objectives. Example of a cattle control deer fence: 36 inches tall, three strand barbed wire fence with top wire being smooth. Spacing of wires from top to bottom: 10 inches, 10 inches, and 16 inches. Place fence posts 16 feet 6 inches apart with twist-on wire stay halfway between posts.
- Enhance existing big game winter range in suitable undisturbed portions of the Project Area to reduce effective loss of winter range.

### Green-tailed Towhee

No additional mitigation measures are proposed for this species.

### Hairy Woodpecker and Bluebird

- Where possible, protect all large-diameter (greater than 16 inch d.b.h.) standing snags from loss to construction activities, especially in ponderosa pine stands. Where no large-diameter snags exist, protect all snags in the largest 10 percent of the stand's diameter class. Preference for large-diameter snags or the largest diameter available has been well documented for many cavity constructor species. This mitigation would minimize the loss of snags thereby reducing impacts to snag-dependant wildlife. Snag protection measures are expected to maintain average snag densities and distributions within the overall Project Area.
- Inventory for snags and where possible protect all nest cavity trees from loss to construction activities, especially in ponderosa pine stands. Studies have shown a preference for ponderosa pine by cavity constructor species. Because cavity trees are used consistently for many years, this protection measure is expected to be an effective tool for minimizing the impact of project implementation on cavity-dependant wildlife while maintaining actively used nest cavity sites.
- Protect as many large-diameter (greater than 16 inches d.b.h.) live trees with defects as possible to serve as replacement snags, especially those trees with heartwood decay, spike-topped trees, broken-topped trees, and hollow trees. Preference for large-diameter snags has been well documented for many cavity constructor species. This mitigation is expected to maintain live snag-replacement trees of sufficient diameter within the Project Area to maintain long-term habitat value for snag-dependant wildlife.

- Prohibit cutting of standing dead ponderosa pine personal use firewood. This measure is designed to protect snags for cavity dependent wildlife species.

**Brown Trout**

- Due to the low threat to brown trout populations, population monitoring is not recommended. Implementation and effectiveness monitoring of watershed and soil BMPs is strongly recommended. Validation of the "3M" model used to predict water consumption is also recommended.

### 3.9.6.5 Monitoring

Ongoing monitoring conducted in the HD Mountains is two pronged in terms of objectives. First, compliance monitoring would be conducted through the life of the project to determine and maintain project compliance with the mitigation requirements set forth above and elsewhere in Chapter 2, particularly public compliance with road closures and travel management restrictions, industry compliance with surface use mitigation required as APD conditions of approval, and compliance with rehabilitation and weed control requirements.

Second, the FS has conducted inventories and monitoring for selected wildlife species in 2002, 2003 and 2004 to establish pre-project baseline conditions. Species inventoried and monitored include Abert's squirrel, green-tailed towhee, hairy woodpecker, Merriam's turkey, mountain bluebird, and northern goshawk. The Forest Service, in addition, has consulted with the CDOW on available inventory, monitoring, and/or species status information for Abert's squirrel, brown trout, elk, and mule deer.

The FS will continue monitoring these wildlife species. Unless otherwise stated, the following measures will be funded by the Companies. Monitoring of Abert's squirrel and northern goshawk will continue annually or every other year to validate predicted long-term species impacts within the Project Area. Monitoring of green-tailed towhee, hairy woodpecker, and mountain bluebird will occur on an annual basis for at least the first two years of project construction, and every five years thereafter. Monitoring will provide data to assess mitigation effectiveness, species response to project implementation, and compliance with LRMP standards and guidelines. Monitoring will also contribute information to overall population and habitat trend monitoring occurring simultaneously across the SJNF.

The FS will continue intra-agency coordination with the CDOW to obtain available monitoring or status information on, brown trout, elk, and mule deer within the Project Area and across the SJNF. As with the other MIS, effectiveness monitoring of mitigation measures recommended for game species will be conducted to determine effectiveness, and need for change.

Snag surveys are recommended around project infrastructure facilities (well pads, compressor stations, primary roads, spur roads, etc.) as well as away from project roads and infrastructure to monitor compliance with LRMP snag density standards and guidelines. Surveys would quantify the number, diameter, condition class and density of snags and specifically target ponderosa pine stands as well as the density of trees larger than 16 inches d.b.h. Surveys at infrastructure sites should be conducted prior to construction activities within areas to be cleared to gauge the impacts of project implementation and the relationship to LRMP standards and guidelines.

## 3.9.6.6 Conformance to Existing Plans and Policies

The LRMP direction for wildlife consists of forest direction and management area direction (FS 1992). The forest direction details overall management requirements that are to be achieved or maintained across the SJNF over time. Management area direction presents more specific direction for areas of land on the SJNF called management areas. Management areas are zones within a larger landscape.

The following LRMP (FS 1992) direction and guidelines apply to NFS land within the Project Area.

### *3.9.6.6.1 Forest Direction*

Maintain habitat for viable populations of all existing vertebrate wildlife species (FS 1992:III–26). The management guideline for this direction is to maintain habitat for each vertebrate species on the SJNF at least at 40 percent or more of potential.

### *3.9.6.6.2 Management Area Direction*

Management direction for five management areas: 2B, 3A, 4B, 5B, and 6B apply to the Project Area. For vertebrate species, the 40-percent habitat potential guideline applies to management areas 2B, 3A and 5B (35,000 acres), a 60-percent habitat potential guideline applies to management area 6B (6,000 acres) and an 80-percent guideline applies to management area 4B (12,000 acres). Additionally an 80-percent guideline applies to deer and elk habitat in management area 5B.

The 4B management area is within the HD Mountains Roadless area and has no prior history of timber management, or roading and has received light grazing over the past few decades. The 6B management area is in the Sauls Creek area and has a history of timber harvest and tree thinning that dates back to the 1940s. The 6B area emphasizes range management, the tree stands are mostly even-aged ponderosa pine, 12-inch average d.b.h. with a fairly closed canopy, very well interspersed with meadows. The 6B area has also experienced CBM development beginning in the early 1990s. To determine whether the SJNF portion of the Project Area is currently meeting these standards, we reconstructed actions and trends that may have impacted wildlife habitat potential.

The NFS portion of the project area has experienced changes in vegetative cover type and composition as a result of timber harvest, fire suppression, and grazing. Timber harvest has converted approximately 6,000 acres of old, large mature pine to younger, more uniform stands of saw timber sized stands in the Sauls Creek area and along the east flank of Pargin Mountain. Recorded timber harvest began on the 1940s. In addition, we suspect that there was much earlier harvest along the flanks of the HD Mountains due to settlement in and around La Plata County that removed the large tree component of many stands.

Fire suppression and grazing have contributed to the following trends: There is less grassland today than in the past due to slow encroachment of pinyon-juniper into grassland ecosystems. Similarly, there is less sagebrush meadow due to pinyon-juniper encroachment. The ongoing Forest Service use of prescribed fire in these cover types has slowed this encroachment, however. Some ponderosa pine stands along the ecotone with mixed conifer have experienced slow encroachment of mixed conifer, which could also be reversed through prescribed fire management. Mixed conifer stands have become denser, and more dominated by white fir than in the past. Finally, aspen, gambel oak and spruce-fir stands have continued to mature. The continued maturation of aspen could result in partial loss of its representation where stands are not self-regenerating.

In addition, portions of the HD Mountains have been roaded over time. Currently, about 28,000 acres of the 49,500-acre area remains unroaded. Many of the roads are closed to motorized vehicles providing for habitat security, but there is moderate use of the Saul's Creek road system during all seasons and moderate use of the entire area's roads by ATVs during hunting season. During winter, roads are closed and snowed out. Many roads are also gated during the summer to restrict public use.

With these habitat changes and the limited wildlife-human interaction, the HD Mountains Area continues to provide habitat for vertebrate species at least at 40-percent of potential. The 12,000 acre 4B management area most likely also provides habitat at 80-percent of potential because it continues to remain unroaded, unlogged, lightly grazed, and isolated from recreational activities. The 6,000-acre 6B management area, located generally around Sauls Creek presents somewhat more of a complicated set of circumstances due to past harvest, roading and recreational use. The concern of the biologist team on the SJNF is that the area may not be meeting the 60-percent habitat potential guideline for hairy woodpecker, and bluebird and the other species they represent as MIS. There is concern that a lack of snags in Sauls Creek may adversely affect hairy woodpecker and bluebird habitat. Further field investigation will be conducted to determine whether the 6B area is currently meeting the 60-percent habitat potential guideline.

Each of the alternatives would affect habitat capability in different ways and in different areas. Alternative 2 would have the greatest impact, followed in descending order by Alternatives 1, 1A, 4, 3, 1B, and 5. The largest impact would be in the ponderosa pine habitat, resulting in approximately a 5-percent physical reduction in pine habitat in Alternative 2, and lesser impacts in the other alternatives. The physical habitat alteration and loss of habitat would not in itself result in a measurable change in habitat capability when compared to the current situation. In addition, the 4B management area would remain unroaded and undeveloped under Alternatives 1, 1A, 1B 3, and 5, maintaining that area at least at 80 percent of habitat capability. Alternatives 2 and 4 would develop much of the 4B area and there would be a slight loss of habitat capability.

A change in road management would be implemented in Alternatives 1 through 3 to restrict on and off road motorized travel to a few designated routes. All other routes would be closed to public use (see Recreation section of this chapter). This mitigation is designed to significantly reduce human-wildlife conflict and resultant loss in wildlife habitat capability. However, non-CBM related foot and horseback traffic during hunting season would seasonally reduce habitat capability across the entire HD Mountains area. With the change in road management, the same habitat conclusions would apply: The HD Mountains would continue to provide for 40 percent habitat capability under all alternatives. The 4B management area would continue to provide for 80-percent habitat capability in Alternatives 1, 1A, 1B, 3, and 5, but would experience reduced capability in Alternatives 2 and 4. The 6B management area would continue to provide for 60 percent of habitat capability for all alternatives, for all species, with the possible exception of hairy woodpecker, bluebird, and the species they represent. The 60-percent habitat capability standard can be maintained or promoted for these species through management that includes tree thinning and prescribed fire in the grassland, sagebrush and pine types and prohibitions on standing dead tree harvest. These activities would be accomplished through wildlife habitat improvement projects.

#### *3.9.6.6.3 Other Applicable LRMP Guidelines*

Maintain one Abert's squirrel nest-tree clump (0.1 acre of 9-inches-to-22-inches-d.b.h. ponderosa pine with a basal area of 180 to 220 and an interlocking canopy) per two acres on all ponderosa pine sale areas (FS 1992:III–147). No systematic inventory data exist that show whether the SJNF is meeting this guideline. However, based on knowledge of pine forest characteristics in the Project Area, it is likely that the SJNF is meeting this guideline. The SJNF would continue to meet the guideline under all alternatives because only a small proportion of ponderosa pine habitats (0.5 to 5 percent) would be affected under each alternative.

For woodpecker and bluebird and the wildlife species they represent, protect and provide 25 snags/10 acres in forested types, also provide for snag replacement. Through on-site observations, we believe that the snag guideline is not being met in portions of the pine type, particularly in Sauls Creek. Further field investigation will be conducted to ascertain snag density. The alternatives would not contribute measurably to additional snag loss.

For big game, specifically deer and elk, provide for 80 percent habitat capability within 5B management areas. The 5B management areas specifically emphasize management for big game winter range. The guideline would be met in the 5B area under all the alternatives. The control of vehicular access during the winter months is prescribed to specifically maintain winter habitat capability for deer, elk, and other wildlife species in general.

Other LRMP guidelines apply to wildlife habitat structural improvements and/or habitat guidelines that would be maintained or accomplished through timber sales, and do not apply to this project.

## 3.9.7 Federally Listed Threatened and Endangered Species

The Biological Assessment (Appendix H) was prepared in accordance with the legal requirements set forth under Section 7(c) of the ESA, and FS and BLM Manual direction to address potential effects to listed species from the proposed project. This section summarizes Appendix H.

### 3.9.7.1 Affected Environment

The fish and wildlife species of concern are listed in the current Rocky Mountain Region endangered, threatened, proposed, and sensitive species list (FS 2001d). Based on a screening of the list, it was determined that four of these species are not expected to occur in the Project Area. Species thus eliminated from further evaluation include: Canada lynx, bonytail chub, humpback chub, and Uncompahgre fritillary butterfly. The specific rationale for this elimination is presented in Appendix H.

The remaining threatened and endangered species may occur in the Project Area. Table 3–101 shows their preferred habitats and the acreage and proportion of suitable habitats for each species in the Project Area. General information about each species is presented in Appendix H.

**Table 3–101 Extents and Proportion of Threatened and Endangered Species Habitats in the Project Area**

| Species | Preferred Habitats | Habitats in Project Area (acres) | Portion of Project Area (percent) |
|---|---|---|---|
| Bald eagle | Nests in large trees or snags near larger streams, rivers, lakes, and reservoirs. Winter roosts in timber stands usually near rivers or other water features. Forages widely, focused on open water and wetland areas, also in uplands. | 11,553[1] | 9 |
| Mexican spotted owl | Associated with steep canyons and cliffs in or near mature forests of ponderosa pine and mixed conifer (especially Douglas-fir). | 0 | 0 |
| Southwestern willow flycatcher | Riparian habitats along rivers, streams, or other wetlands, with dense growths of willows and other shrubs, often with a scattered overstory of cottonwood; surface water or saturated soil is required. | 534[2] | <1 |
| Colorado pikeminnow and razorback sucker | Colorado pikeminnow: adults prefer deeper areas of river channels while first-year fish utilize quiet backwater areas and side channels.<br>Razorback sucker: low runs, shallow to deep pools, backwaters, eddies, and other slow velocity areas with sandy substrates. | San Juan River[3] | 0 |

Notes:

1. Winter Concentration Area. There are no designated winter roost or nesting areas in the Project Area.
2. Includes 457 acres of suitable habitat and 67 acres of potential habitat.
3. Downstream of the Project Area.

### 3.9.7.2 Environmental Consequences

The amount of habitat that is available for each species and that would be impacted under each alternative is shown in Table 3–102 for federally listed threatened and endangered species. The proportion of the Project Area that is suitable for each species and the proportion of suitable habitats that would be lost impacted under each alternative are shown in Table 3–103. Each alternative would reduce available habitat for most species; however, the proportion of available habitats that would be lost is small.

The Proposed Action may affect but is not likely to adversely affect the bald eagle and bald eagle habitat in the Project Area. The Proposed Action will disturb 48 acres, or 0.4 percent, of the winter concentration areas in the Project Area. Cumulatively, the Proposed Action when combined with other CBM related activities in the cumulative impact analysis area will impact 826 acres (3 percent) of bald eagle winter concentration areas. Committed conservation measures would be implemented (Section 3.9.6.4) to avoid adverse effects to the bald eagle and bald eagle habitat.

**Table 3–102 Amounts of Habitats Available and Affected by each Alternative for each Federally Listed Threatened and Endangered Species on All Lands in the Project Area**

| Species | Habitats Available (acres) | Habitats Affected by Alternative (acres) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Bald eagle | 11,553 | 48 | 43 | 47 | 115 | 69 | 41 | 37 |
| Mexican spotted owl | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Southwestern willow flycatcher | 534 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Colorado pikeminnow and razorback sucker | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 3–103 Proportion of Habitats Available and Affected by each Alternative for each Federally Listed Threatened and Endangered Species on All Lands in the Project Area**

| Species | Habitats Available (percent) | Habitats Affected by Alternative (percent) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Bald eagle | 9 | <1 | <1 | <1 | 1 | <1 | <1 | <1 |
| Mexican spotted owl | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Southwestern willow flycatcher | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Colorado pikeminnow and razorback sucker | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

The Proposed Action may affect, but is not likely to adversely affect the Mexican spotted owl, and marginally suitable habitat. This determination is based on the results of periodic survey in areas of potentially suitable habitat, and the lack of any detection within the Project Area. There has been no critical habitat identified in the Project Area. The impact to 16 acres of marginally suitable habitat is not expected to degrade the value of the approximate 1,980 acres of habitat in Ignacio Creek/Canyon. Cumulatively, the Proposed Action will not result in adverse impacts to MSO habitat present elsewhere in the SJB, or affect populations that may exist elsewhere in the Basin or in Northern New Mexico.

The Proposed Action may affect, but is not likely to adversely affect the southwestern willow flycatcher or flycatcher habitat. The proposed action will not impact suitable habitat, and committed conservation measures are designed to avoid occupied habitat.

Reduced surface flows and altered water quality can degrade the quantity and quality of aquatic habitat both within and downstream of the Project Area. It has been determined that the amount and quality of water delivered to the lower San Juan River determines habitat suitability for the two endangered fishes (USFWS 1995b, SJRB RIP 2003). As a result, it has been the position of the USFWS that any depletion of water from the San Juan Basin, regardless of magnitude, timing, duration, or source, contributes to the overall cumulative effect of water depletions on the endangered fishes and has the potential to jeopardize the viability of the population. In keeping with previous findings for like actions, we conclude that the Proposed Action may affect, and is likely to adversely affect, the Colorado pikeminnow and razorback sucker.

The Proposed Action may affect, but is not likely to adversely affect Knowlton's cactus based on discountable effects. This determination is based on the fact that there are no known occurrences of this species in the Project Area, because surveys done in the Project Area have not found it, and the fact that if the species is found in the Project Area through pre-construction surveys, no ground-disturbing activities will occur within the buffered area surrounding that population of Knowlton's cactus.

### 3.9.7.3 Cumulative Effects

#### *3.9.7.3.1 Bald Eagle*

Within the 546,600-acre cumulative effects area, there are 3 bald eagle nests and approximately 27,500 acres of bald eagle winter concentration areas (BLM et al. 2002).

The cumulative effect of the Proposed Action combined with all other existing and proposed oil and gas development would cause a total surface disturbance of 826 acres, or 3 percent of bald eagle winter concentration areas in the cumulative effects analysis area. The Proposed Action would not increase potential impacts to nesting bald eagles because there are no bald eagle nests in the Project Area. Committed conservation measures that prescribe nest avoidance would prevent effects in the event that a bald eagle nest is established in the Project Area. The 243 acres of known winter roosting habitat east of the Project Area would not be impacted by the Proposed Action. Mitigation measures would be implemented to minimize or avoid impacts to any newly discovered winter roost areas as determined by surveys.

Other cumulative effects could result from activities on private lands, such as sand and gravel mining, ranching, agriculture, road construction, and rural and urban housing development. Approximately 86 percent of the bald eagle winter concentration areas in the Project Area are located on private lands, primarily along the river valleys where future development could be most intense. Effects on bald eagles from these activities would be in addition to the cumulative effects that have been quantified. Additional background information and details on cumulative effects are presented in the BA (Appendix H).

#### 3.9.7.3.2 Mexican Spotted Owl

Within the 546,600-acre cumulative effects area there are approximately 56,000 acres of mixed conifer and ponderosa pine that may provide foraging habitat for the MSO (BLM et al. 2002). Approximately 1,559 acres, or 2.8 percent, of this area would be impacted by oil and gas development on a cumulative basis.

Other cumulative effects could result from activities on private lands. These effects are not quantifiable but there is little if any suitable MSO habitat on these other land ownerships.

#### 3.9.7.3.3 Southwestern Willow Flycatcher

The Proposed Action would not impact SWWFs or their habitats in the Project Area. Committed conservation measures would prevent disturbance of habitats and restrict project activities from occurring in occupied habitats and during the breeding season.

Within the bounds of the SUIT Reservation, the SUIT EIS predicts that a maximum of 5.9 percent of the wooded riparian areas in the study area would be impacted (BLM et al. 2002). The impact of this disturbance on SWWF habitat is unclear because these areas were not examined to assess their suitability for use by SWWFs. However, committed mitigation measures implemented by the SUIT restrict surface-disturbing activities during the breeding season if any SWWFs are located. These measures would minimize disturbance of SWWF habitat. Therefore, the primary impact to SWWFs from oil and gas development in the cumulative effects analysis area would be any loss of habitat that cannot be avoided on private land within the cumulative effects area. The extent of the impact is not currently quantifiable, but is expected to be a small portion of the available habitats.

Sand and gravel mining, livestock grazing, agriculture, road construction, and rural and urban housing development could also impact SWWF habitat. In the past, these activities have likely caused degradation or loss of substantial amounts of SWWF habitats (Marshall and Stoleson 2000) although no specific data are available for the cumulative effects analysis area. Considering the anticipated growth patterns, these activities are expected to continue into the future and may affect SWWFs because most of their habitats are on private lands, where there is little regulatory control.

#### 3.9.7.3.4 Knowlton's Cactus

Within the cumulative effects area, 5,217 acres of suitable habitat for Knowlton's cactus have been impacted by CBM development, and an additional 3,655 acres of suitable habitat for Knowlton's cactus would be disturbed by oil and gas development within the cumulative effects area (BLM et al. 2002).

Since there are no known prior adverse effects to Knowlton's cactus within the cumulative effects analysis area resulting from past activities, and since there would be no adverse effects to Knowlton's cactus within the cumulative effects analysis area resulting from the Proposed Action or oil and gas development on

Tribal lands, there would be minimal adverse cumulative effects to Knowlton's cactus. Impacts could occur on private land if prior surveys are not conducted.

Mitigation measures and pre-construction surveys designed to avoid effects to Knowlton's cactus from all project activities have been and would continue to be implemented and would minimize the potential for any adverse effects or cumulative adverse effects to this species.

#### 3.9.7.3.5 Colorado Pikeminnow and Razorback Sucker

The analysis area for cumulative effects to the Colorado pikeminnow and razorback sucker includes the Project Area and the San Juan River watershed downstream of the Project Area to Lake Powell.

Approximately 846,000 acre-feet of water per year are annually depleted by a wide variety of current uses. Included in this total are 66 acre-feet per year that would be depleted by new CBM development in the SUIT EIS study area immediately south of the Northern Basin Project Area (BLM et al. 2002).

Although the depletions associated with the alternatives are small relative to total depletions within the basin, they would contribute to the overall cumulative effect of water depletions on both the Colorado pikeminnow and the razorback sucker.

Impacts to water quality caused by increased sediment loads, and the possibility of spills of fuels, lubricants, drilling fluids, or produced water, are not likely to have measurable effects on habitats of the endangered fishes. The probability of contaminating spills is low and best management practices would control sedimentation, which would be localized in impact. Given the distance between the Project Area and the occupied habitats, impacts would be minimal. Although it is reasonable to assume the CBM impacts would be minor, how these impacts might function in combination with the other cumulative effects to water quality, and how they might eventually influence habitats used by the pikeminnow and sucker, is uncertain.

### 3.9.7.4 Mitigation and Monitoring

Unless otherwise stated, the following measures will be funded by the Companies.

#### 3.9.7.4.1 Bald Eagle

- Conduct surveys of nesting and potential roosting areas during appropriate seasons each year before site-specific project activities begin to determine if nest and roosting sites are active. Times and locations for these surveys shall be established in consultation with the Authorized Officer.

- Construct well pads, compressor stations, and ROWs at least ¼ mile from active bald eagle nests and active winter roosts.

- Restrict activities other than routine maintenance that could disturb nesting within ½ mile of an active bald eagle nest between January 1 and July 1.

- No activities other than routine well activities (activities that are conducted in the course of maintaining production operations at a well site such as daily site visits, minor repairs on surface equipment or removal of produced water by truck) shall take place within bald eagle winter concentration areas between November 15 and March 15, unless approved by the Authorized Officer. If the Authorized Officer approves routine well activities within bald eagle winter concentration areas between November 15 and March 15, it shall be restricted to a period between 9:00 a.m. and 3:00 p.m.

- Emergency workovers that are necessary and proposed to take place between November 15 and March 15 in bald eagle winter concentration areas, such as pump replacement/repair, plugged tubing, swabbing or associated operations to unload fluids from a well, a hole in the tubing or activities to repair a wellbore and/or surface equipment in order to ensure environmental protection will be approved by the Authorized Officer. These activities are limited to daylight hours only and will be of short duration.

- Avoid removal of large cottonwood, ponderosa pine, or other trees within bald eagle winter concentration areas, winter roosts, and areas that may provide nesting habitat.

- Construct aboveground power lines using raptor protection measures (Avian Power Line Interaction Committee [APLIC] 1994, APLIC 1996) that are designed to reduce the potential for avian collision and electrocution.

### 3.9.7.4.2 Mexican Spotted Owl

- Implement Mexican spotted owl management guidelines according to the Mexican Spotted Owl Recovery Plan should any breeding or resident owls be discovered in the Project Area (USFWS 1995a).

### 3.9.7.4.3 Southwestern Willow Flycatcher

- Conduct surveys for the southwestern willow flycatcher during the preconstruction phase. Times and location of surveys shall be established in consultation with the Authorized Officer (breeding surveys will occur between May 15 and July 20, and will be in accordance with the latest USFWS protocol). In the absence of completed and approved surveys, all suitable southwestern willow flycatcher habitats shall be assumed to be occupied.

- Prohibit disturbance to occupied southwestern willow flycatcher habitat by siting facilities a minimum of 100 meters away from such habitat. If birds are located during survey efforts, no surface disturbing activities would be conducted from May 1 to August 15.

- Avoid disturbance to suitable southwestern willow flycatcher habitat by siting facilities a minimum of 100 meters away from such habitat.

- Minimize construction in wooded riparian habitats.

- BMPs for riparian/wetland areas will be implemented to avoid adverse impacts to these habitats.

#### 3.9.7.4.4 Colorado Pikeminnow and Razorback Sucker

- Use BMPs to avoid contamination of local streams and rivers to protect the Colorado pikeminnow and razorback sucker.

#### 3.9.7.4.5 Knowlton's Cactus

- A professional botanist will conduct pre-construction surveys for Knowlton's cactus in all potential areas of disturbance that are identified as suitable habitat (all lands within the pinyon-juniper and sagebrush vegetation types, and all other lands below 8000 feet in elevation) during the pre-construction phase of the project. Since Knowlton's cactus is extremely inconspicuous except when in flower, pre-construction surveys for Knowlton's cactus will occur between April 1 and May 15 when the species is most likely to be flowering.

- Avoid Knowlton's cactus plants and populations and the buffers around them that may be affected by activities.

### 3.9.7.5 Conformance to Existing Plans and Policies

Management of federally listed threatened and endangered species generally falls under the requirements of the ESA, as administered by the USFWS. Management of these species by other agencies, such as the BLM and FS are based on compliance with the ESA and USFWS directives. The BA (Appendix H) satisfies the requirements of the ESA.

## 3.9.8 FS Sensitive Species

The biological evaluation (BE) addresses FS sensitive wildlife species. This section summarizes the BE (Appendix I).

### 3.9.8.1 Affected Environment

Species that are candidate for sensitive species evaluation are listed in the current Rocky Mountain Region endangered, threatened, proposed, and sensitive species list (FS 2001d). A number of these species are not expected to occur in the Project Area. Species therefore eliminated from further evaluation include: American marten, wolverine, common loon, ferruginous hawk, osprey, Columbian sharp-tailed grouse, white-faced ibis, American bittern, greater sandhill crane, black tern, western yellow-billed cuckoo, boreal owl, black swift, boreal toad, Texas horned lizard, and Colorado River cutthroat trout.

Table 3–104 lists the remaining FS sensitive wildlife species that may occur in the Project Area and describes their preferred habitats and the acreage and proportion of suitable habitats for each species in the Project Area.

### 3.9.8.2 Environmental Consequences

The amount of habitat that is suitable for each species and the amount that would be impacted under each alternative are shown in Table 3–105. The proportion of the Project Area that is suitable for each species and the proportion of suitable habitats that would be impacted under each alternative are shown in Table 3–106.

Each alternative would cause a minor loss of available habitat for most species, on order of 4-percent loss or less.

### Table 3–104 Extent and Proportion of Habitats for FS Sensitive Species

| Species | Preferred Habitats | Habitats on NFS Land in the Project Area (acres) | Portion of NFS Land in Project Area (percent) |
|---|---|---|---|
| Dwarf shrew | Variety of habitat types including: spruce-fir bogs; coniferous forests; sedge marsh; dry, brushy hillsides; and open woodland, generally above 5,500 feet. | 46,078 | 93 |
| Spotted bat | Ponderosa pine forests, pinyon-juniper woodlands, and open desert shrublands. Areas of prominent rocky cliffs are necessary to provide suitable cracks and crevices for roosting. | 24,819 | 50 |
| Townsend's big-eared bat | Coniferous forest, deciduous riparian woodland, and semi-desert and montane shrublands. Roosting habitat consists most frequently of caves and abandoned mines but also includes buildings, bridges, rock crevices, and hollow trees. | 24,819 | 50 |
| Ringtail | Rocky canyon and foothills areas of pinyon-juniper woodlands, montane shrublands, or mixed conifer-oak brush. Water and denning cavities such as rock crevices and tree cavities are necessary. | 39,188 | 79 |
| Northern goshawk | Mid- and late-successional habitats including ponderosa pine, mixed conifer, and aspen. | 11,831 | 24 |
| Merlin | Grasslands, agricultural areas, riparian forests, and urban areas during the winter months. | 39,642 | 80 |
| Western burrowing owl | Non-forested plains, grasslands, deserts, with short vegetation; largely dependant on burrowing mammals, such as prairie dogs, badgers, gophers or foxes for burrows. | 4,678 | 9 |
| Flammulated owl | Typically inhabits open stands of mature to old growth ponderosa pine forests with well-developed grass or shrub understories and nests in cavities in larger snags. | 34,501 | 70 |
| Lewis' woodpecker | A primary cavity nester, preferring areas of large ponderosa pine and cottonwood, particularly in open areas with scattered large trees. | 24,723 | 50 |
| Three-toed woodpecker | Nests most commonly in spruce/fir forests but also occurs in ponderosa pine, Douglas-fir, lodgepole pine, and aspen forests when insect populations are high. Population levels vary greatly depending on insect abundance. | 24,852 | 50 |
| Olive-sided flycatcher | Mature spruce/fir, Douglas-fir, montane and foothill riparian, and aspen forests. Prefers open forested areas with large trees for nesting and foraging. | 24,878 | 50 |
| Purple martin | A secondary cavity nester in mature aspen, and may also be found in mixed aspen/ponderosa pine or aspen/Douglas-fir forests. Observed in riparian areas, open agricultural areas, and reservoirs during migration. | 24,878 | 50 |
| Pygmy nuthatch | Mature ponderosa pine communities, preferring open park-like stands. Also occasionally uses spruce/fir, mixed conifer, pinyon/juniper, and riparian woodlands. Nests and roosts in natural or excavated cavities. | 24,878 | 50 |
| Golden-crowned kinglet | Mature, dense spruce/fir forest, also ponderosa pine, pinyon/juniper woodlands, foothill and lowland riparian forests, and in planted conifers in parks and residential areas. | 33,273 | 67 |

## Table 3–104 Extent and Proportion of Habitats for FS Sensitive Species

| Species | Preferred Habitats | Habitats on NFS Land in the Project Area (acres) | Portion of NFS Land in Project Area (percent) |
|---|---|---|---|
| Loggerhead shrike | Nesting habitat includes sagebrush, desert scrub, pinyon/juniper woodlands, and woodland edges. Non-breeding habitat includes prairies and agricultural lands to montane meadows. | 14,327 | 29 |
| Fox sparrow | Riparian willow shrublands and wet, willow-grown meadows, especially those within spruce/fir forests. Generally at 7,500 to 11,000 feet in elevation. | 4,382 | 9 |
| Tiger salamander | Ponds, lakes, and natural and man-made reservoirs ranging in size from ten feet across to several acres. Can survive in a variety of water conditions. | 28 | <1 |
| Northern leopard frog | Banks and shallows of marshes, ponds, lakes, reservoirs, beaver ponds, streams, and other permanent bodies of water, especially those with rooted vegetation or associated with beaver complexes. | 28 | <1 |
| Milk snake | Grasslands, sandhills, canyons, rocky hillsides, open stands of ponderosa pine, pinyon-juniper woodland, and arid river valleys, generally below 8,000 feet. | 43,762 | 89 |

## Table 3–105 Amounts of Habitats Available and Affected by each Alternative for each FS Sensitive Species on NFS Lands in the Project Area

| Species | Habitats Available (acres) | Habitats Affected by Alternative (acres) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Aztec milkvetch | 11,007 | 136 | 73 | 80 | 234 | 88 | 99 | 11 |
| Giant helleborine | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pagosa skyrocket | 38,725 | 573 | 351 | 265 | 941 | 307 | 337 | 83 |
| Pagosa Springs bladderpod | 22,998 | 436 | 240 | 115 | 806 | 218 | 281 | 46 |
| Dwarf shrew | 46,078 | 672 | 422 | 297 | 1,075 | 353 | 379 | 88 |
| Spotted bat | 24,819 | 411 | 259 | 133 | 858 | 246 | 287 | 48 |
| Townsend's big-eared bat | 24,819 | 411 | 259 | 133 | 858 | 246 | 287 | 48 |
| Ringtail | 39,188 | 675 | 353 | 265 | 950 | 307 | 340 | 83 |
| Northern goshawk | 11,831 | 235 | 163 | 176 | 264 | 142 | 113 | 37 |
| Merlin | 39,642 | 615 | 377 | 298 | 915 | 369 | 352 | 86 |
| Western burrowing owl | 4,678 | 78 | 43 | 44 | 98 | 68 | 36 | 4 |
| Flammulated owl | 34,501 | 455 | 332 | 254 | 801 | 299 | 313 | 81 |
| Lewis' woodpecker | 24,723 | 455 | 255 | 197 | 821 | 242 | 272 | 48 |
| Three-toed woodpecker | 24,852 | 423 | 276 | 191 | 590 | 234 | 217 | 72 |
| Olive-sided flycatcher | 24,878 | 423 | 276 | 191 | 590 | 234 | 217 | 72 |
| Purple martin | 24,878 | 423 | 276 | 191 | 590 | 234 | 217 | 72 |
| Pygmy nuthatch | 24,878 | 423 | 276 | 191 | 590 | 234 | 217 | 72 |
| Golden-crowned kinglet | 33,273 | 523 | 320 | 244 | 776 | 299 | 311 | 81 |
| Loggerhead shrike | 14,327 | 190 | 98 | 107 | 316 | 133 | 127 | 14 |
| Fox sparrow | 4,382 | 65 | 41 | 10 | 84 | 22 | 39 | 3 |
| Tiger salamander | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Northern leopard frog | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Milk snake | 43,762 | 649 | 395 | 304 | 1,048 | 375 | 371 | 88 |

**Table 3–106 Proportions of Habitats Available and Affected by each Alternative for each FS Sensitive Species on NFS Lands in the Project Area**

| Species | Habitats Available (percent) | Habitats Affected by Alternative (percent) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Aztec milkvetch | 22 | 1 | <1 | <1 | 2 | <1 | <1 | <1 |
| Giant helleborine | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pagosa skyrocket | 78 | 1 | <1 | <1 | 2 | <1 | <1 | <1 |
| Pagosa Springs bladderpod | 47 | 2 | 1 | <1 | 4 | <1 | 1 | <1 |
| Dwarf shrew | 93 | 2 | 1 | 1 | 2 | <1 | <1 | <1 |
| Spotted bat | 50 | 2 | 1 | 1 | 3 | <1 | 1 | <1 |
| Townsend's big-eared bat | 50 | 2 | 1 | 1 | 3 | <1 | 1 | <1 |
| Ringtail | 79 | 2 | 1 | 1 | 2 | <1 | <1 | <1 |
| Northern goshawk | 24 | 2 | <1 | <1 | 2 | 1 | 1 | <1 |
| Merlin | 80 | 2 | 1 | 1 | 2 | <1 | <1 | <1 |
| Western burrowing owl | 9 | 2 | 1 | 1 | 2 | 1 | <1 | <1 |
| Flammulated owl | 70 | 2 | 1 | 1 | 2 | <1 | <1 | <1 |
| Lewis' woodpecker | 50 | 2 | 1 | 1 | 3 | <1 | 1 | <1 |
| Three-toed woodpecker | 50 | 2 | 1 | 1 | 2 | <1 | <1 | <1 |
| Olive-sided flycatcher | 50 | 2 | 1 | 1 | 2 | <1 | <1 | <1 |
| Purple martin | 50 | 2 | 1 | 1 | 2 | <1 | <1 | <1 |
| Pygmy nuthatch | 50 | 2 | 1 | 1 | 2 | <1 | <1 | <1 |
| Golden-crowned kinglet | 67 | 2 | 1 | 1 | 2 | <1 | <1 | <1 |
| Loggerhead shrike | 29 | 1 | 1 | 1 | 2 | <1 | <1 | <1 |
| Fox sparrow | 9 | 1 | 1 | <1 | 2 | <1 | <1 | <1 |
| Tiger salamander | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Northern leopard frog | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Milk snake | 89 | 1 | 1 | 1 | 2 | <1 | <1 | <1 |

Appendix I presents the affected environment and environmental consequences determinations for each sensitive species evaluated in detail. Table 3–107 summarizes the impact determinations for both FS and BLM sensitive species.

### 3.9.8.3 Cumulative Effects

The alternatives would result in the same types of impacts to individual wildlife and their habitats as presented in Section 3.9.4, and with the same relative level of impact between alternatives as described in Section 3.9.4. Cumulative impacts would include loss of habitat, loss of habitat effectiveness (through impacts such as increased road density, hunting pressure/harassment, and displacement), vehicle collisions, and habitat fragmentation over the broader cumulative effects area. The intensity and duration of impacts would be as described for the Project Area. In general, Alternative 2 would be the most impacting from a direct and cumulative impacts standpoint, followed in descending order by Alternatives 1, 1A, 4, 3, 1B, and 5. Over the cumulative effects area, the impacts to individual sensitive species and their viability would be as described in Table 3–107.

## Table 3–107 Summary of Impact Determinations

| Species | Evaluated in Detail? | Determinations | | | | |
|---|---|---|---|---|---|---|
| | | Alt. 1, 1A, 1B | Alt. 2 | Alt. 3 | Alt. 4 | Alt. 5 |
| Southern maidenhair fern | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Reflected moonwort | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Pale moonwort | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Altai cotton-grass | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Colorado tansy-aster | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| American marten | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Wolverine | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| American bittern | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Black swift | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Osprey | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Long-billed curlew | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Common loon | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Ferruginous hawk | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Gunnison sage grouse | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Columbian sharp-tailed grouse | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| White-faced ibis | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Greater sandhill crane | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Black tern | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Western yellow-billed cuckoo | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Boreal owl | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Boreal toad | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Texas horned lizard | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Colorado River cutthroat trout | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Desert spiny lizard | No | No Impact | No Impact | No Impact | No Impact | No Impact |
| Aztec milkvetch | Yes | MAII[1] | MAII | MAII | MAII | MAII |
| Giant helleborine | Yes | MAII | MAII | MAII | MAII | MAII |
| Pagosa skyrocket | Yes | No Impact | No Impact | No Impact | No Impact | No Impact |
| Pagosa springs bladderpod | Yes | No Impact | No Impact | No Impact | No Impact | No Impact |
| Dwarf shrew | Yes | MAII | MAII | MAII | MAII | MAII |
| Spotted bat | Yes | MAII | MAII | MAII | MAII | MAII |
| Townsend's big-eared bat | Yes | MAII | MAII | MAII | MAII | MAII |
| Ringtail | Yes | MAII | MAII | MAII | MAII | MAII |
| Northern goshawk | Yes | MAII | MAII | MAII | MAII | MAII |
| Merlin | Yes | MAII | MAII | MAII | MAII | MAII |
| Western burrowing owl | Yes | No Impact | No Impact | No Impact | No Impact | No Impact |
| Flammulated owl | Yes | MAII | MAII | MAII | MAII | MAII |
| Lewis' woodpecker | Yes | MAII | MAII | MAII | MAII | MAII |
| Three-toed woodpecker | Yes | MAII | MAII | MAII | MAII | MAII |
| Olive-sided flycatcher | Yes | MAII | MAII | MAII | MAII | MAII |
| Purple martin | Yes | MAII | MAII | MAII | MAII | MAII |
| Pygmy nuthatch | Yes | MAII | MAII | MAII | MAII | MAII |
| Golden-crowned kinglet | Yes | MAII | MAII | MAII | MAII | MAII |
| Loggerhead shrike | Yes | MAII | MAII | MAII | MAII | MAII |
| Fox sparrow | Yes | MAII | MAII | MAII | MAII | MAII |
| Tiger salamander | Yes | MAII | MAII | MAII | MAII | MAII |
| Northern leopard frog | Yes | MAII | MAII | MAII | MAII | MAII |
| Milk snake | Yes | MAII | MAII | MAII | MAII | MAII |

Note:

1. MAII = May adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability range wide.

### 3.9.8.4 Mitigation and Monitoring

The following mitigation and monitoring measures are specific to the Aztec milkvetch, giant helleborine, Pagosa skyrocket, and Pagosa Springs bladderpod. There are no specific mitigation measures that apply to the remaining FS sensitive species. Section 3.9.3 contains general wildlife mitigation measures applicable to FS sensitive species that are not repeated here. Unless otherwise stated, the following measures will be funded by the Companies.

#### *3.9.8.4.1 Sensitive Plant Species Mitigation*

Conduct pre-construction surveys for Aztec milkvetch, giant helleborine, Pagosa skyrocket, and Pagosa Springs bladderpod in all potential areas of disturbance that are identified as suitable habitat for these species during the pre-construction phase of the project.

- Avoid individuals and populations of these species that may be affected by activities.

**Table 3–108 Extent of Cumulative Loss of Habitats for Forest Sensitive Species from Oil and Gas Development in Cumulative Effects Analysis Area**

| Species | Habitats Available (acres) | Habitats Affected by Alternative (acres) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Aztec milkvetch | 262,450 | 14,050 | 13,987 | 13,995 | 14,226 | 14,001 | 14,009 | 13,914 |
| Giant helleborine | 8,829 | 495 | 495 | 495 | 495 | 495 | 495 | 495 |
| Pagosa skyrocket | 260,513 | 11,228 | 11,007 | 10,917 | 11,774 | 10,965 | 10,992 | 10,718 |
| Pagosa Springs bladderpod | 300,871 | 15,330 | 15,193 | 15,148 | 15,750 | 15,190 | 15,236 | 15,050 |
| Dwarf shrew | 377,319 | 18,019 | 17,768 | 17,639 | 18,653 | 17,702 | 17,728 | 17,416 |
| Spotted bat | 414,395 | 22,131 | 21,988 | 21,941 | 22,618 | 21,991 | 22,021 | 21,827 |
| Townsend's big-eared bat | 414,395 | 22,131 | 21,988 | 21,941 | 22,618 | 21,991 | 22,021 | 21,827 |
| Ringtail | 288,307 | 12,851 | 12,629 | 12,537 | 13,429 | 12,587 | 12,616 | 12,339 |
| Northern goshawk | 26,715 | 1,572 | 1,411 | 1,329 | 1,813 | 1,387 | 1,372 | 1,220 |
| Merlin | 441,020 | 22,914 | 22,675 | 22,595 | 23,444 | 22,672 | 22,652 | 22,371 |
| Western burrowing owl | 178,872 | 10,847 | 10,812 | 10,812 | 10,956 | 10,839 | 10,806 | 10,772 |
| Flammulated owl | 234,355 | 10,444 | 10,240 | 10,163 | 10,834 | 10,211 | 10,223 | 9,978 |
| Lewis' woodpecker | 411,766 | 22,043 | 21,902 | 21,850 | 22,503 | 21,905 | 21,932 | 21,744 |
| Three-toed woodpecker | 57,346 | 1,572 | 1,425 | 1,340 | 1,813 | 1,387 | 1,372 | 1,220 |
| Olive-sided flycatcher | 66,175 | 2,067 | 1,920 | 1,835 | 2,307 | 1,882 | 1,867 | 1,714 |
| Purple martin | 66,175 | 2,067 | 1,920 | 1,835 | 2,307 | 1,882 | 1,867 | 1,714 |
| Pygmy nuthatch | 66,175 | 2,067 | 1,920 | 1,835 | 2,307 | 1,882 | 1,867 | 1,714 |
| Golden-crowned kinglet | 241,866 | 10,925 | 10,723 | 10,647 | 11,301 | 10,705 | 10,715 | 10,473 |
| Loggerhead shrike | 355,881 | 19,719 | 19,627 | 19,634 | 19,997 | 19,663 | 19,656 | 19,530 |
| Fox sparrow | 13,403 | 560 | 536 | 504 | 584 | 517 | 533 | 498 |
| Tiger salamander | 9,013 | 496 | 496 | 496 | 496 | 496 | 496 | 496 |
| Northern leopard frog | 9,013 | 496 | 496 | 496 | 496 | 496 | 496 | 496 |
| Milk snake | 456,029 | 23,115 | 22,861 | 22,764 | 23,791 | 22,846 | 22,840 | 22,534 |

**Table 3–109 Proportion of Cumulative Loss of Habitats for Forest Sensitive Species from Oil and Gas Development in Cumulative Effects Analysis Area**

| Species | Habitats Available (percent) | Habitats Affected by Alternative (percent) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Aztec milkvetch | 48 | 5.4 | 5.3 | 5.3 | 5.4 | 5.3 | 5.3 | 5.3 |
| Giant helleborine | 2 | 5.6 | 5.7 | 5.6 | 5.6 | 5.6 | 5.6 | 5.6 |
| Pagosa skyrocket | 48 | 4.3 | 4.2 | 4.2 | 4.5 | 4.2 | 4.2 | 4.1 |
| Pagosa Springs bladder-pod | 55 | 5.1 | 4.7 | 5.0 | 5.2 | 5.0 | 5.1 | 5.0 |
| Dwarf shrew | 69 | 4.8 | 4.7 | 4.7 | 4.9 | 4.7 | 4.7 | 4.6 |
| Spotted bat | 76 | 5.3 | 5.0 | 5.3 | 5.5 | 5.3 | 5.3 | 5.3 |
| Townsend's big-eared bat | 76 | 5.3 | 5.0 | 5.3 | 5.5 | 5.3 | 5.3 | 5.3 |
| Ringtail | 53 | 4.5 | 4.4 | 4.3 | 4.7 | 4.4 | 4.4 | 4.3 |
| Northern goshawk | 5 | 2.7 | 2.5 | 2.3 | 3.2 | 2.4 | 2.4 | 2.1 |
| Merlin | 81 | 5.2 | 4.9 | 5.1 | 5.3 | 5.1 | 5.1 | 5.2 |
| Western burrowing owl | 34 | 6.1 | 6.0 | 6.0 | 6.1 | 6.1 | 6.0 | 6.0 |
| Flammulated owl | 43 | 4.5 | 4.4 | 4.3 | 4.6 | 4.4 | 4.4 | 4.3 |
| Lewis' woodpecker | 75 | 5.4 | 5.0 | 5.3 | 5.5 | 5.3 | 5.5 | 5.3 |
| Three-toed woodpecker | 10 | 2.7 | 2.5 | 2.3 | 3.2 | 2.4 | 2.4 | 2.1 |
| Olive-sided flycatcher | 12 | 3.1 | 2.9 | 2.8 | 3.5 | 2.8 | 2.8 | 2.6 |
| Purple martin | 12 | 3.1 | 2.9 | 2.8 | 3.5 | 2.8 | 2.8 | 2.6 |
| Pygmy nuthatch | 12 | 3.1 | 2.9 | 2.8 | 3.5 | 2.8 | 2.8 | 2.6 |
| Golden-crowned kinglet | 44 | 4.5 | 4.4 | 4.2 | 4.7 | 4.4 | 4.4 | 4.3 |
| Loggerhead shrike | 65 | 5.5 | 5.5 | 5.5 | 5.6 | 5.5 | 5.5 | 5.5 |
| Fox sparrow | 2 | 4.2 | 4.0 | 3.8 | 4.4 | 3.9 | 4.0 | 3.7 |
| Tiger salamander | 2 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 |
| Northern leopard frog | 2 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 |
| Milk snake | 83 | 5.1 | 5.0 | 5.0 | 5.2 | 5.0 | 5.0 | 4.9 |

## 3.9.8.5 Conformance to Existing Plans and Policies

The following guidelines from the amended LRMP for the SJNF (FS 1992) apply on NFS lands.

### *3.9.8.5.1 Forest Direction*

**General Direction:** Maintain habitat for viable populations of all existing vertebrate wildlife species (FS 1992:III–26).

No more than four percent of the habitats for any FS sensitive species would be impacted under any alternative (Table 3–106). The potential impacts derived from direct habitat loss, loss of habitat effectiveness and factors that result in habitat fragmentation, would be such that there would either be no impact to the majority of sensitive species (Table 3–107), or the project may adversely impact individuals, but would not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability range wide.

Management areas: 2A, 3B, 4B, 5A, and 6B would meet LRMP guidelines for maintenance of habitat potential as described in Section 3.9.5.3, with the possible exception of the 6B area in Sauls Creek where there is concern about the amount of snags that benefit cavity nesting species. Otherwise, when taken as a whole, the 49,500-acre NFS portion of the Project Area would provide habitat potential that meets the management guidelines for habitat potential on the SJNF.

## 3.9.9 BLM Sensitive Species

Twenty-seven BLM sensitive species were initially considered in this evaluation. Thirteen of these species do not occur in the Project Area. Of the remaining 14, seven are evaluated as FS sensitive or MIS and the complete analysis of these species is presented in the BE (Appendix I) or the MIS Analysis (Appendix J). The remaining seven species are addressed in detail in Appendix K. This section summarizes Appendix K.

### 3.9.9.1 Affected Environment

Table 3–110 presents the preferred habitats for BLM sensitive species evaluated in detail. The table also presents the acres of suitable habitat for each species within the Project Area.

### 3.9.9.2 Environmental Consequences

The amount of habitat that is available for each species and that would be impacted under each alternative is shown in Table 3–111. The proportion of the Project Area that is suitable for each species and the proportion of suitable habitats that would be lost under each alternative are shown in Table 3–112. Each alternative would result in a minor, generally less than 1-percent, loss of suitable habitat for most species. Impacts to individuals and to species viability resulting from the proposed CBM development are presented in Table 3–107.

### 3.9.9.3 Cumulative Effects

The cumulative effects analysis area was previously described. The amount of each wildlife habitat type that would be cumulatively affected under each alternative would be a relatively small proportion of the total amount available, less than 6 percent. Cumulative effects to individuals and species viability would be as described in Table 3–107 over the larger cumulative effects area. The extent, duration and intensity of impacts within the bounds of the SUIT Reservation would be as described for the Project Area (Section 3.9.4), but would occur in a different physical location.

### 3.9.9.4 Mitigation and Monitoring

The following mitigation measures apply to the Pagosa skyrocket, Pagosa Springs bladderpod, and all bat species that are BLM sensitive species. There are no specific mitigation measures that apply to the remaining BLM sensitive species. Section 3.9.3 contains general wildlife mitigation measures applicable to BLM sensitive species that are not repeated here. Unless otherwise stated, the following measures will be funded by the Companies.

## Table 3–110 Extents and Proportion of Habitats for BLM Sensitive Species

| Species[1] | Preferred Habitats | Habitats on BLM Land in the Project Area (acres) | Portion of BLM in Project Area (percent) |
|---|---|---|---|
| Pagosa skyrocket | Discussed in Table 3–106 | 4,630 | 69 |
| Pagosa Springs bladderpod | Discussed in Table 3–106 | 5,203 | 78 |
| Townsend's big-eared bat | Discussed in Table 3–106 | 5,454 | 82 |
| Spotted bat | Discussed in Table 3–106 | 5,454 | 82 |
| Allen's (Mexican) big-eared bat | Canyons forested with oak, pine, and other conifers, also pinyon-juniper, shrublands, and riparian woodlands. Associated with cliffs, outcroppings, or boulder piles. Caves, mines, rock shelters, and other similar types of shelter are preferred for day roosts. | 5,658 | 85 |
| Fringed myotis | Coniferous woodlands at moderate elevations (5,000 to 8,000 feet). Roosts in trees, caves, mines, and abandoned buildings. | 3,540 | 53 |
| Yuma myotis | Commonly associated with riparian areas. Foraging occurs above the surface of lakes, ponds, and streams. Roosts are in rock crevices, buildings, caves, mines, and under bridges or ledges. | 7 | <1 |
| Big free-tailed bat | Typically found in rocky country, where it roosts on high cliffs. | 369 | 6 |
| Northern goshawk | Discussed in Table 3–106 | 848 | 13 |
| Bluehead sucker | Inhabits the relatively cooler, clearer waters of the upper and middle portions of rivers and streams, preferring faster flowing water to rocky substrate. | 0 | 0 |
| Flannelmouth sucker | Inhabits larger streams and rivers in all habitat types including riffles, runs, eddies, and backwaters. | 0 | 0 |
| Roundtail chub | Adults typically occur in slow moving water adjacent to fast moving water. Individuals hold in slow moving areas and enter faster waters to feed. | 0 | 0 |
| Milk snake | Discussed in Table 3–106 | 6,643 | 99 |
| Northern leopard frog | Discussed in Table 3–106 | 7 | <1 |

### Table 3–111 Amounts of Habitats Available and Affected by each Alternative for each BLM Sensitive Species on BLM Lands in the Project Area

| Species | Habitats Available (acres) | Habitats Affected by Alternative (acres) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Pagosa skyrocket | 4,630 | 22 | 22 | 22 | 43 | 22 | 22 | 18 |
| Pagosa Springs bladderpod | 5,203 | 27 | 22 | 22 | 49 | 28 | 28 | 24 |
| Townsend's big-eared bat | 5,454 | 28 | 29 | 29 | 50 | 28 | 28 | 24 |
| Spotted bat | 5,454 | 28 | 29 | 29 | 50 | 28 | 28 | 24 |
| Allen's (Mexican) big-eared bat | 5,658 | 25 | 25 | 25 | 49 | 25 | 25 | 21 |
| Fringed myotis | 3,540 | 18 | 18 | 18 | 33 | 15 | 15 | 12 |
| Yuma myotis | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Big free-tailed bat | 369 | 0 | 0 | 0 | 6 | 0 | 0 | 0 |
| Northern goshawk | 848 | 4 | 2 | 2 | 10 | 7 | 7 | 6 |
| Bluehead sucker | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Flannelmouth sucker | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Roundtail chub | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Milk snake | 6,643 | 30 | 31 | 31 | 55 | 31 | 31 | 27 |
| Northern leopard frog | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

### Table 3–112 Proportions of Habitats Available and Affected by each Alternative for each BLM Sensitive Species on BLM Lands in the Project Area

| Species | Habitats Available (percent) | Habitats Affected by Alternative (percent) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Pagosa skyrocket | 69 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Pagosa Springs bladderpod | 78 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Townsend's big-eared bat | 82 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Spotted bat | 82 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Allen's (Mexican) big-eared bat | 85 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Fringed myotis | 53 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Yuma myotis | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Big free-tailed bat | 6 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| Northern goshawk | 13 | <1 | <1 | <1 | 1 | <1 | <1 | <1 |
| Bluehead sucker | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Flannelmouth sucker | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Roundtail chub | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Milk snake | 99 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Northern leopard frog | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Table 3–113 Extent of Cumulative Loss of Habitats for BLM Sensitive Species from Oil and Gas Development in Cumulative Effects Analysis Area

| Species | Habitats Available (acres) | Habitats Affected by Alternative (acres) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Pagosa skyrocket | 260,513 | 2,096 | 11,745 | 11,562 | 2,145 | 2,088 | 2,101 | 2,069 |
| Pagosa Springs bladderpod | 300,871 | 16,874 | 17,470 | 17,243 | 17,516 | 16,562 | 16,590 | 16,254 |
| Townsend's big-eared bat | 414,395 | 22,043 | 23,353 | 23,223 | 22,520 | 21,905 | 21,933 | 21,744 |
| Spotted bat | 414,395 | 22,043 | 23,353 | 23,223 | 22,520 | 21,905 | 21,933 | 21,744 |
| Allen's (Mexican) big-eared bat | 376,001 | 18,006 | 18,633 | 18,411 | 18,625 | 17,702 | 17,726 | 17,416 |
| Fringed myotis | 233,077 | 10,431 | 10,788 | 10,630 | 10,806 | 10,210 | 10,220 | 9,978 |
| Yuma myotis | 8,829 | 495 | 506 | 506 | 495 | 495 | 495 | 495 |
| Big free-tailed bat | 2,320 | 89 | 128 | 129 | 98 | 86 | 87 | 83 |
| Northern goshawk | 26,715 | 1,572 | 902 | 806 | 1,813 | 1,387 | 1,372 | 1,220 |
| Bluehead sucker | NA | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Flannelmouth sucker | NA | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Roundtail chub | NA | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Milk snake | 456,029 | 23,115 | 23,865 | 23,669 | 23,791 | 22,846 | 22,840 | 22,534 |
| Northern leopard frog | 9,013 | 496 | 507 | 507 | 496 | 496 | 496 | 496 |

## Table 3–114 Proportion of Cumulative Loss of Habitats for BLM Sensitive Species from Oil and Gas Development in Cumulative Effects Analysis Area

| Species | Habitats Available (percent) | Habitats Affected by Alternative (percent) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Pagosa skyrocket | 48 | >1 | 4.5 | 4.4 | >1 | >1 | >1 | >1 |
| Pagosa Springs bladderpod | 55 | 5.6 | 5.8 | 5.7 | 5.8 | 5.5 | 5.5 | 5.4 |
| Townsend's big-eared bat | 76 | 5.3% | 5.6 | 5.6 | 5.4 | 5.3% | 5.3% | 5.2 |
| Spotted bat | 76 | 5.3% | 5.6 | 5.6 | 5.5 | 5.3% | 5.3% | 5.2 |
| Allen's (Mexican) big-eared bat | 69 | 4.8% | 5.0 | 4.9 | 5.0% | 4.7% | 4.7% | 4.6% |
| Fringed myotis | 43 | 4.5% | 4.6 | 4.6 | 4.6% | 4.4% | 4.4% | 4.3% |
| Yuma myotis | 2 | 5.6% | 5.7 | 5.7 | 5.6% | 5.6% | 5.6% | 5.6% |
| Big free-tailed bat | >1 | 3.8% | 5.5 | 5.5 | 4.2% | 3.7% | 3.8% | 3.6% |
| Northern goshawk | 5 | 5.9 | 3.4 | 3.0 | 6.8 | 5.2 | 5.1 | 4.6 |
| Bluehead sucker | NA | NA | NA | NA | NA | NA | NA | NA |
| Flannelmouth sucker | NA | NA | NA | NA | NA | NA | NA | NA |
| Roundtail chub | NA | NA | NA | NA | NA | NA | NA | NA |
| Milk snake | 83 | 5.1% | 5.2 | 5.2 | 5.2% | 5.0% | 5.0% | 4.9% |
| Northern leopard frog | 2 | 5.5% | 5.6 | 5.6 | 5.5% | 5.5% | 5.5% | 5.5% |

### *3.9.9.4.1 Pagosa Skyrocket and Pagosa Springs Bladderpod*

- Conduct pre-construction surveys for Pagosa skyrocket and Pagosa Springs Bladderpod in all potential disturbance areas that are identified as suitable habitat during the pre-construction phase of the project.

- Avoid individuals and populations of Pagosa skyrocket and Pagosa Springs Bladderpod that may be affected by activities.

#### 3.9.9.4.2 Bat Species

- If potential roosting habitat is identified within the Project Area, conduct pre-construction surveys to determine roost occupancy. Develop additional mitigation measures based upon the results of these surveys.

### 3.9.9.5 Conformance to Existing Plans and Policies

The following resource objectives and standards are taken from two primary sources: the San Juan/San Miguel Planning Area RMP (BLM 1985), and the Decision Record and Finding of No Significant Impact for the Standards for Public Land Health and Guidelines for Livestock Grazing Management (Standards) (BLM 1997). These resource objectives and standards are applicable only on BLM lands. The resource objectives and standards discussed below may be affected by the proposed project.

#### 3.9.9.5.1 Resource Objectives

No activities would be permitted in threatened, endangered, or sensitive species habitat that would jeopardize their continued existence (RMP, page 12).

#### 3.9.9.5.2 Standards

**Standard 4:** Special status, threatened, and endangered species (federal and state), other plants and animals officially designated by the BLM, and their habitats are maintained or enhanced by sustaining healthy, native plant and animal communities (Standards, page 7).

The biologist team has concluded (Appendices H and K) that the proposed project would not jeopardize the continued existence of any threatened, endangered, or sensitive species under any of the seven alternatives. Although there may be some minimal impact to some species, viable populations of special status and other plant species and their habitats are likely to be maintained in the Project Area. Mitigation measures would reduce or minimize adverse effects to special status and other species.

## 3.9.10 State of Colorado Threatened, Endangered, and Special Concern Species

Twenty-nine species listed by the State of Colorado as threatened, endangered, or of special concern were initially considered in this evaluation. After examining occurrence information and availability of suitable habitat, 13 of these species are not expected to occur in the Project Area. Of the remaining 16 species, five were also evaluated in the BE (Appendix I), three were evaluated in the BA (Appendix H), and one was evaluated in the MIS Assessment (Appendix J). The remaining 10 State of Colorado threatened, endangered, and special concern wildlife species are addressed in detail in Appendix L. This section summarizes Appendix L.

### 3.9.10.1 Affected Environment

Species eliminated from further evaluation include: boreal toad, Texas horned lizard, desert spiny lizard, whooping crane, greater sandhill crane, ferruginous hawk, Gunnison sage grouse, black-footed ferret, Canada lynx, wolverine, bonytail chub, humpback chub, and Colorado River cutthroat trout.

The remaining state-listed threatened, endangered, and special concern wildlife species may occur in the Project Area. Table 3–115 shows their preferred habitats and the acreage and proportion of suitable habitats for each species in the Project Area.

**Table 3–115 Extents and Proportion of Habitats for State of Colorado Threatened, Endangered, and Special Concern Wildlife Species**

| Species | | Habitats in the Project Area (acres) | Portion in the Project Area (percent) |
|---|---|---|---|
| Northern leopard frog | Discussed in Table 3–104 | 857 | <1 |
| New Mexico spadefoot | Grasslands and shrublands near floodplains below 6,500 feet. Spends much of life underground, emerging to breed in temporary rainwater pools. | 25,505 | 20 |
| Southwestern willow flycatcher | Discussed in Table 3–101 | 673 | <1 |
| Bald eagle | Discussed in Table 3–101 | 39,798 | 32 |
| Mexican spotted owl | Discussed in Table 3–101 | 39,125 | 31 |
| Western burrowing owl | Discussed in Table 3–101 | 27,152 | 22 |
| Peregrine falcon | Nest sites located in cliffs typically exceeding 200 feet in height. Preferred hunting habitats include cropland, meadows, river bottoms, marshes, and lakes. | 73,059 | 58 |
| River otter | Variety of aquatic habitats from marine to high elevation mountain lakes. Preferred habitat is characterized by slow moving water with deep pools, abundant riparian vegetation. | 857 | <1 |
| Razorback sucker | Discussed in Table 3–101 | 183 | <1 |
| Colorado pikeminnow | Discussed in Table 3–101 | 183 | <1 |
| Bluehead sucker | Relatively cooler, clearer waters of the upper and middle portions of rivers and streams, preferring faster flowing water to rocky substrate. | 183 | <1 |
| Flannelmouth sucker | Larger streams and rivers in all habitat types including riffles, runs, eddies, and backwaters, spawning on gravel/cobble bars or riffles. | 183 | <1 |

### 3.9.10.2 Environmental Consequences

The amount of habitat that is available for each species and that would be lost under each alternative is shown in Table 3–116. The proportion of the Project Area that is suitable for each species and the proportion of suitable habitats that would be lost under each alternative are shown in Table 3–117. Each alternative would cause a reduction in suitable habitat for most species; however, the proportion of suitable habitats that would be lost is less than 1 percent. Although there may be some minimal effects to some species, viable populations of special status and other plant species and their habitats are likely to be maintained in the Project Area. Mitigation measures would reduce or minimize adverse effects to special status and other species.

**Table 3–116 Amounts of Habitats Available and Affected by each Alternative for each State Listed Species on All Lands in the Project Area**

| Species[1] | Habitats Available (acres) | Habitats Affected by Alternative (acres) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Northern leopard frog | 857 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| New Mexico spadefoot | 25,505 | 136 | 110 | 97 | 234 | 130 | 94 | 67 |
| Western burrowing owl | 27,152 | 143 | 118 | 106 | 251 | 132 | 100 | 68 |
| Peregrine falcon | 73,059 | 506 | 411 | 316 | 970 | 366 | 394 | 208 |
| River otter | 857 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Razorback sucker | 183 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bluehead sucker | 183 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Flannelmouth sucker | 183 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Note:
1. Species also listed as federally threatened or endangered are discussed in Section 3.9.7

**Table 3–117 Proportions of Habitats Available and Affected by each Alternative for each State Listed Species on All Lands in the Project Area**

| Species | Habitats Available (percent) | Habitats Affected by Alternative (percent) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Northern leopard frog | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| New Mexico spadefoot | 20 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Southwestern willow flycatcher | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Bald eagle | 32 | 1 | <1 | 1 | <1 | <1 | <1 | <1 |
| Mexican spotted owl | 31 | 1 | 1 | <1 | 2 | <1 | <1 | <1 |
| Western burrowing owl | 22 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Peregrine falcon | 58 | <1 | <1 | <1 | 1 | <1 | <1 | <1 |
| River otter | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Razorback sucker | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Colorado pikeminnow | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bluehead sucker | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Flannelmouth sucker | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Roundtail chub | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

### 3.9.10.3 Cumulative Effects

The cumulative effects area was previously described. The amount of each wildlife habitat type that would be cumulatively affected under each alternative would be a relatively small proportion of the total amount available, less than 3 percent (Table 3–118 and Table 3–119). Additional background information and details on cumulative effects are discussed in Appendix I. Viable populations of special status and other plant species and their habitats are likely to be maintained in the cumulative effects area. Mitigation measures would reduce or minimize adverse effects to special status and other species.

**Table 3–118 Extent of Cumulative Loss of Habitats for State Listed Species from Oil and Gas Development in Cumulative Effects Analysis Area**

| Species | Habitats Available (acres) | Habitats Affected by Alternative (acres) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Northern leopard frog | 9,018 | 507 | 507 | 507 | 507 | 507 | 507 | 507 |
| New Mexico spadefoot | 185,296 | 11,503 | 11,480 | 11,467 | 11,594 | 11,498 | 11,471 | 11,448 |
| Southwestern willow flycatcher | 8,835 | 506 | 506 | 506 | 506 | 506 | 506 | 506 |
| Bald eagle | 65,001 | 2,340 | 2,278 | 2,141 | 2,563 | 2,168 | 2,140 | 1,998 |
| Mexican spotted owl | 56,165 | 1,834 | 1,772 | 1,635 | 2,057 | 1,662 | 1,634 | 1,492 |
| Western burrowing owl | 178,781 | 11,124 | 11,102 | 11,090 | 11,225 | 11,117 | 11,091 | 11,066 |
| Peregrine falcon | 410,954 | 22,616 | 22,529 | 22,434 | 23,070 | 22,487 | 22,523 | 22,326 |
| River otter | 9,018 | 507 | 507 | 507 | 507 | 507 | 507 | 507 |
| Razorback sucker | 183 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Colorado pikeminnow | 183 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Bluehead sucker | 183 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Flannelmouth sucker | 183 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Roundtail chub | 183 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**Table 3–119 Proportion of Cumulative Loss of Habitats for State Listed Species from Oil and Gas Development in Cumulative Effects Analysis Area**

| Species | Habitats Available (percent) | Habitats Affected by Alternative (percent) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Northern leopard frog | 2 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| New Mexico spadefoot | 34 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Southwestern willow flycatcher | 2 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Bald eagle | 12 | 4 | 4 | 3 | 4 | 3 | 3 | 3 |
| Mexican spotted owl | 10 | 3 | 3 | 3 | 4 | 3 | 3 | 3 |
| Western burrowing owl | 33 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Peregrine falcon | 75 | 6 | 5 | 5 | 6 | 5 | 5 | 5 |
| River otter | 2 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Razorback sucker | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Colorado pikeminnow | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Bluehead sucker | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Flannelmouth sucker | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Roundtail chub | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |

### 3.9.10.4 Mitigation and Monitoring

The following specific mitigation measures apply to these species that are State of Colorado threatened, endangered, and special concern species. There are no specific mitigation measures that apply to the remaining State of Colorado threatened, endangered, and special concern species in the Project Area. Section 3.9.3 contains general wildlife mitigation measures applicable to these species that are not repeated here. Unless otherwise stated, the following measures will be funded by the Companies.

#### *3.9.10.4.1 Peregrine Falcon*

- Conduct pre-construction surveys for the peregrine falcon in all suitable habitats that would be disturbed. If pre-construction surveys identify active peregrine falcon nests, apply additional mitigation. These measures may include relocation of the proposed well or facility location, avoidance of identified nesting habitats during the appropriate season, and minimization of activities that may disturb peregrine falcon habitats, including identification and preservation of active nests.

#### *3.9.10.4.2 River Otter*

- Minimize construction in riparian areas.

### 3.9.10.5 Conformance to Existing Plans and Policies

There are no specific threatened, endangered, and special concern species plans and policies for the State of Colorado.

## 3.9.11 Unavoidable Adverse Effects

Unavoidable adverse effects are adverse effects that would occur because of the proposed project despite implementation of mitigation measures designed to minimize adverse effects. Portions of wildlife habitats, including community types and habitat structural stages, would be degraded or removed. Small amounts of wetlands and riparian areas would be degraded or removed. Portions of old-growth stands of ponderosa pine would be removed. Post-project restoration would not be completely successful in replacing lost vegetation, at least not for a period of decades to several centuries. Infestations of noxious weeds would increase and displace native vegetation. Fire regimes would be altered. Portions of potential habitats for special status plant species would be lost.

## 3.9.12 Irreversible and Irretrievable Commitment of Resources

Loss of old growth stands of ponderosa pine beyond the life of the project would be an irreversible commitment because restoring functional old growth habitat for wildlife would be an extremely long-term process.

Loss of vegetative cover until reclamation is successful, late-seral habitat structural stages beyond the life of the project, riparian and wetland vegetation over the life of the project, potential habitats for special status plant species, and decreased productivity of native plant communities because of increased infestations of noxious weeds would be irretrievable commitments.

# 3.10 Cultural Resources

## 3.10.1 Issues

Cultural resource sites include the physical locations and material remains of past and present cultures, including properties of traditional religious and cultural importance (hereinafter called traditional cultural properties), and areas of traditional use. Paleontological resources are geological resources and are addressed in the section on geology in the Project Area. The principal issues regarding cultural resource sites, traditional cultural properties, and areas of traditional use in the Project Area are the potential direct, indirect, and cumulative effects of further CBM development.

The following are the issues concerning cultural resources extracted from the public comments. The exact comments can be reviewed in the Scoping Summary report available from BLM and FS at the Public Lands Center in Durango.

*Issue 13: How will further CBM development affect cultural resources and Native Americans?*

The following are specific facets of this issue:

- *How will further CBM development affect sites, historical properties, traditional cultural properties, and areas of traditional use?*
- *How will further CBM development contribute cumulatively to impacts to cultural resource sites?*
- *Will intensive (Class III) surveys be conducted on all proposed facility sites, as well as Section 106 compliance reports?*
- *How will CBM development affect cultural resource sites within the Southern Ute Indian Reservation immediately downstream and downbasin of the Project Area?*

## 3.10.2 Affected Environment

### 3.10.2.1 Regional Characterization

The Project Area is in the northeastern portion of the geographic and cultural region known as the Four Corners, where the states of Colorado, New Mexico, Arizona, and Utah meet. It lies within the southeast Animas drainage unit and the southwest Upper San Juan-Piedra drainage unit. Elevations in the Animas drainage unit range from 1,830 to 2,300 meters in much of the southern portion of the unit. The biotic communities that are present, in descending order of elevation from north to south, are: alpine tundra (small portion); spruce-fir forest and pine-Douglas-fir forest; Gambel, scrubland, pinyon-juniper woodland; and sagebrush-saltbush. Much of the Upper San Juan-Piedra drainage unit is more than 2,300 meters in elevation. The most prevalent biotic community in the unit is the pine-Douglas-fir forest, with smaller amounts of spruce-fir forest and pinyon-juniper woodland. Sagebrush and saltbush occur along the lower river valleys (Lipe et al. 1999:20).

The principal tributaries of the Animas, Los Pinos (Pine), Piedra, and San Juan Rivers are perennial in these units, providing more reliable water sources than in some other parts of the region.

### 3.10.2.2 Overview of Prehistoric Periods (10,000 B.C. to A.D. 1840)

The following discussion of major prehistoric cultural periods is adapted from Lipe et al. (1999). The prehistoric cultural chronology for the region is classified into eight periods, beginning with Paleoindian and ending with Post-Puebloan or Protohistoric (for example, Ute and Navajo), with some overlap or variation in the date ranges. Brief characterizations of the prehistoric cultural periods are included in Table 3–120 to identify the kinds of sites that are known from each period in the general area of the project and that may be anticipated.

**Paleoindian (10,000 to 8000 B.C.):** No component of the Paleoindian Period has been formally reported in the Project Area. Few Paleoindian components have been identified in the Southern Colorado River Basin, with the majority of these components identified in the Dolores and Yellow Jacket areas west of the analysis area. The scarcity of archaeological remains dating to this period would make even small finds that could be firmly identified as Paleoindian potentially very important.

**Archaic (7500 to 500 B.C.):** Only 11 site components dating to the Archaic period have been identified in the Project Area. This long cultural period is somewhat better represented in areas of more extensive pinyon-juniper woodlands west of the Project Area, roughly the same drainage units where Paleoindian components have been identified. The identification of early lithic sites as Archaic rather than Paleoindian in the field is often based on "cruder" biface technology, higher proportions of locally available lithic raw materials, the presence of ground stone artifacts, and the lack of ceramics.

**Basketmaker (1000 B.C. to A.D. 750):** Sites that can be ascribed to this period and that have intact features, discrete activity areas, or in situ buried levels are potentially important.

In the classic Pecos classification, Basketmaker II (1000 B.C. to A.D. 500), or simply Basketmaker, was a preceramic early agricultural period. Some of the Basketmaker II sites in the Animas unit, and perhaps more widely in the Project Area, are identified because they are associated with a complex of attributes considered characteristic of this period (Lipe et al. 1999:137). A number of Basketmaker II sites have been excavated in the general vicinity of the study area, including several near the Animas River, and two to the south in the lower Navajo Reservoir area of New Mexico.

## Table 3–120 Prehistoric Culture Periods Potentially Represented in the Project Area

| Culture Period | Dates | Architectural/ Structural Features | Living and Storage Features | Artifact Types | Characteristics | Research Issues |
|---|---|---|---|---|---|---|
| Paleoindian | 10,000-6000 B.C. | None known | None known | Large, well-made stemmed or concave base dart or spear points: Angostura, Great Basin Stemmed, Agate Basin, Plano Complex, Pryor Stemmed, Folsom. | Nomadic hunting and gathering subsistence based on large fauna. | Recognition and categorization of sites.<br>Sites poorly dated; more information on chronology needed.<br>Paleoindian-Archaic transition. |
| Archaic | (7500-500 B.C.) | Basin-shaped, possible pit house structures. | Unlined and stone-lined firepits. | Stemmed and side-notched projectile points of Oshara Tradition (Jay, Bajada, San Jose, Armijo, En Medio phases).<br>Manos (grinding stones) for plant processing. | Hunting and gathering subsistence with dependence on smaller fauna.<br>Habitation sites, base camps, satellite sites.<br>Introduction of maize by 400 B.C. | Sites poorly dated; more information on chronology needed.<br>Maize agriculture and Late Archaic-Basketmaker transition. |
| Basketmaker II | 1000 B.C.-A.D. 500 | Rockshelters.<br>Shallow circular pithouses with walls of cribbed logs and mud mortar. | Hearths, heating pits, deflector slabs.<br>Large storage pits (jar-shaped, basin-shaped, slab-lined). | Large corner-notched, expanding stem dart points.<br>T-shaped drills.<br>Manos and basin- and trough-shaped metates (grinding slabs).<br>Basketry with half-rod-bundle foundation and noninterlocking stitches.<br>Little or no pottery. | Maize agriculture.<br>Habitation sites with structures, campsites, limited activity sites, rock art.<br>Evidence of external connections and trade. | Improved chronologies.<br>Cultural origins.<br>Subsistence, settlement patterns, social organization.<br>External connections and trade. |
| Basketmaker III | A.D. 500-750 | Circular to subrectangular pithouses with antechamber or ventilator.<br>No substantial surface structures. | Interior hearths, deflector slabs, slab-lined storage bins.<br>Exterior storage cists, small domed storage structures, hearths. | Corner-notched projectile points.<br>Bow and arrow.<br>Plain pottery, predominantly brown wares and some later distinctive gray wares: Sambrito, Chapin Gray, Chapin Black-on-white, Rosa Gray, early red wares. | Maize agriculture.<br>Single- and multiple-residence habitations sites, possible farmsteads or field houses, artifact scatters, rock art.<br>Formation and dissolution of hamlets (small communities). | Origin of Basketmaker III populations.<br>Population immigrations.<br>Landscape use.<br>Lifeway changes.<br>Peak of occupation during this period. |

## Table 3–120 Prehistoric Culture Periods Potentially Represented in the Project Area

| Culture Period | Dates | Architectural/ Structural Features | Living and Storage Features | Artifact Types | Characteristics | Research Issues |
|---|---|---|---|---|---|---|
| Pueblo I | A.D. 750-900 | Surface structures, pueblos with multiple room blocks, stone walls, earth-and-stone walls, jacal walls, complete masonry.<br>Square to rectangular pit structures with rounded corners, ventilators, wing walls, benches, posts or rafter beams. | Interior hearths, deflector slabs, sipapus, and slab-lined storage bins.<br>Exterior storage pits, hearths, and trash middens. | Corner-notched projectile points with large tangs and small (sometimes contracting) stem.<br>Manos and metates.<br>Ceramics: predominantly plain gray, neckbanded gray ware, Piedra Black-on-white, and decorated red wares. | Shift in agricultural strategy based on water control and irrigation.<br>Villages/settlements, multiple-residence sites (large hamlets), one- to two-household residences (small hamlets), public architecture (such as great kivas or water control features), field houses, artifact scatters (with or without features).<br>Changes in community organization. | Standards for artifact classifications.<br>Evaluation of site types.<br>Settlement patterns and village formation.<br>Culture history, aggregation, migration, cultural genesis. |
| Pueblo II | A.D. 900-1150 | Circular earth-walled or masonry pit structures with ventilators.<br>Small room blocks of pole-and-adobe construction.<br>Great houses with multiple-story construction, massive masonry walls, and blocked-in kivas. | Interior fire basins, storage pits. | Small corner-notched arrow points with concave base and narrow stem.<br>Manos, metates, metate bins.<br>Ceramics: Moccasin Gray, Mancos Gray, Chapin Gray, Cortez Black-on-white, White Mesa Black-on white, Bluff Black-on-red, Chapin Gray, Mancos Corrugated, Dolores Corrugated, Mesa Verde Corrugated, trade ware from lower San Juan, Kayenta, Cibola, Lowry Ruin areas. | Variety of agricultural practices.<br>One- to two-family homesteads<br>Public architecture (great kivas and great houses, roads, water and soil control features).<br>Chaco Canyon culture influence.<br>Rock art panels.<br>Long-distance trade systems. | Immigration from west and south (New Mexico).<br>Chacoan social, economic, or ceremonial influence.<br>Cultural tradition of Chimney Rock Phase.<br>Role of warfare and violence. |
| Pueblo III | A.D. 1150-1300 | Kivas with masonry walls.<br>Surface room blocks.<br>Cliff dwellings.<br>D-shaped (often multi-walled) masonry structures. | Interior fire basins, storage pits. | Small unstemmed triangular, stemmed, side-notched projectile points.<br>Metates and metate bins.<br>Ceramics: Dolores and Mesa Verde Corrugated, McElmo and Mesa Verde Black-on-white, Tsegi Orange Ware polychrome, some red wares. | Maize agriculture (decline in production).<br>Rapid population increase.<br>Pecked-face block masonry.<br>Community cluster of kiva and associated surface rooms.<br>Public architecture (great kivas, great houses, plazas, check dams, D-shaped structures, tower complexes).<br>Shift in settlement from mesa top to canyon.<br>Shift away from eastern canyons to western canyons. | Regional population and population dynamics.<br>Sedentism and mobility.<br>Social organization, aggregation, political hierarchy.<br>Trade and extraregional relationships.<br>Role of warfare and violence.<br>Relationships to contemporary Native American groups. |

## Table 3–120 Prehistoric Culture Periods Potentially Represented in the Project Area

| Culture Period | Dates | Architectural/ Structural Features | Living and Storage Features | Artifact Types | Characteristics | Research Issues |
|---|---|---|---|---|---|---|
| Post-Puebloan and Protohistoric (Ute/Navajo) | A.D. 1300-1840 | Sweat lodges, wickiups (Ute), forked pole hogans with polygonal floor area (Navajo). | Exterior midden areas, hearths, storage pits. | Desert Side-notched or Cottonwood Triangular arrow points.<br>Ceramics: Ute brown ware, Dinétah Gray, Gobernador Polychrome. | Navajo pueblitos, residential sites, sweat lodges, artifact scatters with associated features, simple artifact scatters.<br>Special use and bark procurement sites. | Timing and entry of Ute into southwestern Colorado.<br>Changes brought by introduction of the horse into Ute culture.<br>Athapaskan (Navajo or Diné and Apache) entry into and exit from southwestern Colorado. |

Basketmaker III (A.D. 500 to 750) or Late Basketmaker is much more strongly represented by known sites in this region than any of the earlier periods. Sites of this period can be difficult to recognize during surface inventory. An increase in the number of sites that represent the Basketmaker III period when compared with earlier periods could indicate a research bias that recognizes these sites more readily, a simple increase in population, or the peak of Ancestral Puebloan occupation in the Project Area. These sites are associated with new technologies for pottery manufacture, architecture, hunting, and agriculture, and probably are at least partially associated with immigration into the region (Lipe et al. 1999:193).

**Pueblo (A.D. 750 to 1300):** Pueblo I (A.D. 750 to 900) is the most strongly represented prehistoric period of the known components in the general Project Area. Pueblo I is represented by slightly fewer components than Basketmaker III in the Animas drainage unit, while this period is more strongly represented in the Upper San Juan/Piedra unit. Site components of this period are currently the most abundant recorded in the Project Area.

**Pueblo II (A.D. 900 to 1150):** In general, early Pueblo II settlement is characterized by dispersed clusters of small habitation sites in the Project Area. In the Upper San Juan/Piedra area there is an increase in sites at higher elevations. Fewer Pueblo II sites than Pueblo I or Basketmaker III sites occur within the Project Area.

In general, the principal occupations of the popularly known cliff dwellings and large open sites of southwest Colorado, such as in Mesa Verde National Park, date to the Pueblo III period (A.D. 1150 to 1300). Well-documented sites of this period are much more common west of the Project Area, particularly in the Monument-McElmo, Ute, and Mesa Verde/Mancos drainage units. Where sites of the early part of this period are fairly numerous, they exhibit a pattern of large focal or community center sites with conspicuous public architecture contrasting with small, widely dispersed habitation sites. It is difficult to evaluate whether comparable patterns occurred in the Project Area because components of this period are so scarce.

**Post-Puebloan/Protohistoric (A.D. 1300 to 1840):** Components identified in the Project Area as Post-Puebloan include protohistoric and historic materials, as well as earlier Numic (Ute) and Athapaskan (Navajo or Apache) components. Later Protohistoric habitation sites are often associated with ceramic styles and residential structures that continue in use into the historic period, but smaller and more transient sites may be associated with lithic technologies that overlap between the two groups.

### 3.10.2.3 Historic Overview (A.D. 1664 to Present)

Major historical patterns in the area are summarized to provide a background for evaluating historic sites. The historic sites recorded in the Project Area include 24 houses or homesteads, 12 ranches or farms, 2 isolated farm or ranch features, 11 urban or commercial buildings, 10 canals or ditches, 6 trash scatters, 4 railroad grade segments, and 10 sites of various other types. Major historical patterns in the general area include:

**Spanish Frontier (1664 to 1822):** Spanish settlements of the northern frontier of New Mexico traded with Ute bands in the 17th and 18th centuries, and several Spanish expeditions entered the area. Probably the most widely known expeditions were those of Juan de Rivera in the 1760s and of Domínguez and Vélez de Escalante in 1776. Later, principal trading routes west from Santa Fe crossed through northwest New Mexico along the San Juan River, and prospectors entered the area. In the late 1850s, government-sponsored expeditions, including Marcy in 1857 and 1858 and Macomb in 1859, crossed through the general area. As important as some of these early events may be to history, they were small and transient in the Project Area and are not likely to have left much in the way of cultural resources. Pre-1850 European materials found in the Project Area are more likely to be materials traded to Native Americans than items carried into the region by European explorers, traders, or trappers. Key events and patterns in the history of this region are summarized by Husband (1984).

**Ute Conflicts and Reservations (1850 to 1890):** By the mid 1800s, the Project Area was essentially Ute territory, although Navajo and Apache groups also used the region. Anglo miners and settlers made few inroads into southwest Colorado until after the Colorado gold rush of 1859. Conflicts quickly escalated, and initial attempts at defining a Ute reservation were made with the Evans Treaty of 1863. The Hunt Treaty of 1868 established a Ute reservation that encompassed most of western Colorado, including the Project Area. However, 5 years later, the Brunot Agreement withdrew about 4 million acres in the mineral-rich San Juan region from the reservation. Conflicts between the Ute and Anglo miners and settlers continued, culminating in the Thornburgh battle on Milk Creek and the “Meeker Massacre” near the White River Agency in the north of the reservation. The northern Ute were removed to Utah in 1881, and by 1889, all but the present small Southern Ute and Ute Mountain Ute reservations had been opened to settlement. Sites of this period are small, transient, and difficult to identify.

**Mining and Railroads (1868 to Present):** Prospecting and settlement began in earnest after the Ute Reservation and Ute agencies were established in 1868. Silverton emerged quickly as a small regional hub in the San Juans, but Durango was not established until 1881. At first, supply centers such as Silverton and Ouray were served by wagon roads, but the railroads were struggling to reach them. Several early, well-known toll roads, including the Durango, Parrott City, and Fort Lewis Toll Road, served the region. The Denver and Rio Grande Railroad reached Silverton in 1882, and in 1887 the Denver and Rio Grande Western reached Ouray from Montrose (Fraser and Strand 1997), supplanting some of the major freight roads. Early mining camps in the Project Area are scarce in comparison to the mountains to the north. In contrast, early freight roads, stage roads, and railroad grades are relatively common in certain portions of the Project Area.

Early history in southwest Colorado was dominated by the hard-rock mining industry. Durango was established in anticipation of the arrival of standard gauge railroad and large smelters were built there. By the 1890s, development of increasingly effective milling techniques at the mining centers, followed by the Silver Panic, began to decrease the importance of the smelting industry. However, coal from La Plata coal fields remained important. Mining, early roads, and railroads have left scars and debris on the landscape within the Project Area.

Some of these sites have been obliterated by later development, but others may provide unique insights into early history in the region.

**Early Farming and Ranching (1868 to 1900):** Ranching, initially established in this region to supply the precious metal mining towns, also remained strong after the Silver Panic. Cattlemen entered the region as soon as it was opened for settlement, and by the late 1870s, there were large herds in the Montezuma, Paradox, and San Miguel valleys (Husband 1984:71). The cattle industry, like the mining industry, depended on the railroads to reach eastern markets.

Commercial farming, like the cattle industry, first entered the region to supply the mining towns. Transportation problems, water management, the brief growing season, and the Ute Indians hampered early attempts. Fruit orchards attained success by the early 1900s in Montezuma and La Plata Counties. Irrigation and water rights became important issues soon after the region was settled, and by the mid-1880s, regional irrigation and water supply companies were being formed. Large reservoir and irrigation projects were planned, and by the early 1900s, the federal government was becoming increasingly involved in these projects. Many of these projects were important to the development of the region, and large water projects are continuing to expand.

Farming and ranching resources are likely to be found in the Project Area. For example, known sites include sheep and cattle camps, historic aspen carvings (often associated with sheep and cattle herders), and the Pine-Piedra Stock Driveway. These resources are likely to be more abundant and varied in the western portion of the Project Area.

**Logging and the Lumber Industry (1870-1933)**: The intensive development of mining and the growth of towns and railroads depended, to a large degree, on the availability of lumber (Husband 1984). In the 1890s, railroads, such as the Rio Grande and Pagosa Springs Railroad formed by the New Mexico Lumber Company, were incorporated to run from New Mexico north to the timber regions near Pagosa Springs. In 1899, businessman A.T. Sullenberger incorporated both the Rio Grande and Pagosa and Northern Railroad and the Pagosa Lumber Company. The Pagosa Lumber Company dominated the lumber industry in the region until 1916 and even built a railroad spur into the timbered hills north of Pagosa Springs in 1905. By 1913, Edgar Biggs, C.D. McPhee, and J.J. McGinty of the New Mexico Lumber Company had obtained logging rights to large stands of timber north of Dolores. By 1933, through depletion of resources and the Depression, these early operations had ceased to operate. A few remains of logging towns, sawmills, skids, wagon roads, and railroad spurs exist in the Project Area.

The impact of large, open-range herds and the demands of mining quickly created concern for the health of timber stands and watersheds, and in 1891, several national forest reserves and permit and quota systems for grazing were established. The demand for lumber was so strong that logging interests prevailed even after the national forests were created.

### 3.10.2.4 Native American Traditional Cultural Properties and Areas of Traditional Use

The National Historic Preservation Act of 1966 and its implementing regulations (36 CFR 800) require consultation with federally recognized Indian tribes to identify traditional cultural properties and consider potential effects on such properties as a result of a federal undertaking. In addition, FLPMA, NEPA, the American Indian Religious Freedom Act (AIRFA), and Executive Order No. 13007: "Indian Sacred Sites" contain requirements for consulting with tribes on the potential effects of federal undertakings. Traditional cultural properties are properties of traditional religious and cultural importance. Areas of traditional use may include areas traditionally used to gather plants, animals, or fish for subsistence or for ceremonial or medicinal purposes. Many tribes may claim affinity to these properties and areas within the Project Area. Native American tribal input has not been received for the present project. Native American concerns identified for past projects in the region have focused on protection of archaeological sites and of traditionally used plants. No systematic or comprehensive study of traditional places or resources has been conducted for the Project Area.

Tribes with potential ties to the Project Area and cultural affiliations to cultural resource sites include:

Southern Ute
Northern Ute
Ute Mountain Ute
Navajo
Jicarilla Apache
Hopi
Zuni
Pueblo of Acoma
Pueblo of Cochiti
Pueblo of Isleta
Pueblo of Jemez
Pueblo of Laguna
Pueblo of Nambe
Pueblo of Picuris
Pueblo of Pojoaque
Pueblo of San Felipe
Pueblo of San Ildefonso
Pueblo of San Juan
Pueblo of Sandia
Pueblo of Santa Ana
Pueblo of Santa Clara
Pueblo of Santo Domingo
Pueblo of Taos
Pueblo of Tesuque
Pueblo of Zia

Consultation is under way with these groups to identify traditional cultural properties and areas of traditional use to incorporate and consider in this analysis. Consultation will continue with those groups who identify concerns through project implementation.

### 3.10.2.5 Summary of Known Cultural Resource Sites

The following paragraphs briefly summarize what is known in the Project Area for each cultural period. This brief summary of known sites in the Project Area is based on a files search conducted at the Colorado Office of Archaeology and Historic Preservation (OAHP) in February 2001. As of the summer of 2000, less than 12 percent of the Project Area had been surveyed for the presence of cultural resources. Known site densities in surveyed areas range from 1 site per square mile up to 35 sites per square mile. The files search for the Project Area contained 735 recorded sites, isolated finds, and isolated features.

Although there has not been a systematic recording of traditional cultural properties within the Project Area, tribal consultations for identification of traditional cultural properties and areas of traditional use are an ongoing process. Archaeological site types recorded in the Project Area include open architectural sites, open camps, artifact scatters, lithic procurement sites, and peeled trees.

Archaeological sites may include multiple components (distinct cultural units that reflect multiple time periods) because they have been occupied more than once. These numbers exclude components that were unclassified or were listed as unknown prehistoric and components that were classified simply as "Puebloan" or "Anasazi." Table 3–121 lists the number of archaeological components and isolated finds identified to the archaeological periods described earlier (N=462).

**Table 3–121 Prehistoric Isolated Finds and Archaeological Site Components by Time Period**

| Affiliation | Number | Portion (percent) |
|---|---|---|
| Paleoindian | 0 | 0 |
| Archaic | 11 | 2.4 |
| Basketmaker | 5 | 1.1 |
| Basketmaker III | 136 | 29.4 |
| Pueblo I | 182 | 39.4 |
| Pueblo II | 86 | 18.6 |
| Pueblo III | 7 | 1.5 |
| Protohistoric/Historic | 35 | 7.6 |
| Total | 462 | 100 |

Two archaeological districts listed in the National Register of Historic Places exist within or adjacent to the Project Area. The Spring Creek Archaeological District (site 5LP1254, also known as Zabel Canyon Indian Ruins) lies within the Project Area. Listed in the National Register of Historic Places in 1983, the Spring Creek Archaeological District includes more than 100 sites listed in the Colorado OAHP database. Twenty-five of the sites were listed as contributing to the theme of the district in the original nomination form. Types of prehistoric sites within the district include pit structures, open architecture, room blocks, open lithic (chipped and ground stone) scatters, and concentrations of ceramics (pottery sherds). The district shows a long occupancy from as early as 300 B.C., dated primarily through ceramic styles. Cultural periods are represented from Basketmaker II through Pueblo I, with some Pueblo II and Protohistoric.

East of and adjacent to the Project Area, the Chimney Rock Archaeological Area (CRAA, site 5AA985) lies on 3,160 acres of San Juan National Forest land bounded by the Southern Ute Indian Reservation. Listed in the National Register of Historic Places in 1970, the CRAA is the best-known late Pueblo II settlement cluster in the upper San Juan Basin. Hundreds of individual sites dot the landscape. The Chimney Rock phase is dated from about A.D. 1000 to 1125 and is exemplified by a large aggregation of habitation sites surrounding a Chacoan-style great house known as Chimney Rock Pueblo. The CRAA has been only partially surveyed, but there are at least 91 structures that may have been permanent, plus 27 work camps near farming areas, adding up to more than 200 individual rooms. The high mesa holds 16 individual sites, 14 of which are residential. Four of these sites, the Great Kiva, Pit House, Ridge House, and Great House Pueblo, have been excavated and stabilized.

The overall average site density documented by previous Section 106 investigations within the Project Area is 10.8 sites per square mile. Additional sites in the Project Area are known from early investigations prior to the cultural resource management process established by the National Historic Preservation Act. Approximately 31 percent of known sites (124) in the Project Area are listed on the National Register, contribute to the eligibility of a National Register District, or are recommended as eligible for the National Register, and are therefore considered historic properties. In addition, 23.5 percent of the known sites (95) are unevaluated and will require additional investigations to properly assess their eligibility. If it is assumed that the proportion of eligible to ineligible sites will be the same for the sites that have not been evaluated, then as many as 40 percent of sites in the Project Area may be eligible.

Native American tribal input is ongoing for the present project. Native American input for past projects has focused on avoidance and protect of archaeological sites and maintenance of traditionally used plant populations. No specific traditional cultural properties or areas of traditional use have been recorded in the Project Area, with the exception of some locations of plant colonies that may have been used for gathering. No Areas of Critical Environmental Concern (ACEC) for cultural resource sites in the Project Area have been identified by the FS or BLM.

## 3.10.3 Environmental Consequences

Cultural resource sites can include historic or prehistoric artifact scatters, buildings or structures, landscape modifications, portable and non-portable art, buried features, or traditional cultural properties and places of traditional use. These manifestations of past human activity can be considered significant and eligible for listing in the National Register of Historic Places. Evaluation of significance is based on four criteria: (a) association with past historical or traditional events or pattern of events, (b) association with the contributions of an individual important in history or tradition, (c) representation of an artistic, structural, or engineering tradition, or (d) potential to yield information important in history or prehistory. All of these kinds of importance are associated to some extent with the location or context where they are found. For example, the physical setting of a site is a key component in its eligibility for the National Register of Historic Places. Development of CBM involves local areas of earth disturbance, including the drilling location itself, laydown and support areas, access roads, pipelines, and additional support facilities such as meter stations and water handling facilities. Any earth-disturbing activities can destroy or diminish not just the buildings, structures, and objects, but the setting and context that are part of their importance. Direct physical effects to resources from construction and operation of CBM facilities are immediate and irreversible. The preferred management strategy for cultural resource sites within the area of potential effect is to avoid and protect the sites from direct and indirect impacts.

Section 106 of the National Historic Preservation Act requires that federal agencies take into account the effects of a federal undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. According to Section 301 of the act, "undertaking" means a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including (a) those carried out by or on behalf of the agency, (b) those carried out with federal financial assistance, (c) those requiring a federal permit license, or approval, and (d) those subject to state or local regulation administered pursuant to a delegation or approval by a federal agency. Section 106 compliance also applies to non-federal lands when federal funding, licensing, permitting, and approval are required; when federal minerals are involved; when access to federal minerals involves private land; or when the area of potential effect extends beyond project boundaries. Because the permission of the landowner is required to conduct Section 106 compliance work on private or state lands, the federal agency will work cooperatively with other landowners to fulfill Section 106 compliance responsibilities.

The cultural resource survey and technical report are the basic data-gathering procedure of Section 106 and NEPA compliance. Intensive (Class III) inventory will be conducted in areas of ground disturbance within the area of potential effect where no previous intensive (Class III) inventories have been completed. Section 106 compliance reports are required to document the results of cultural resource inventories and must be completed to proceed with project implementation. A Programmatic Agreement (PA) will be developed among the Advisory Council on Historic Preservation (ACHP), the Colorado State Historic Preservation Officer (SHPO), the San Juan Public Lands (FS and BLM), and consulting parties as identified through consultations, that specifies the Section 106 compliance process that will be used for the Project Area.

In general, the direct, indirect, and cumulative effects of CBM development on cultural resource sites and traditional cultural values are localized. Some indirect effects, such as visual and auditory intrusion or acceleration of deterioration caused by vibration, may extend a half-mile or more from the source, but are still essentially local. Indirect effects to the Southern Ute Indian Reservation and other areas downstream and downbasin of the Project Area are also concerns. However, no downstream effects, such as accelerated erosion, on cultural resource sites, traditional cultural properties, or areas of traditional use have been identified in other sections of this analysis.

Indirect effects to cultural resource sites are not always as obvious or immediate as direct effects and can include effects that occur off site from the areas of construction and operation. Indirect effects can result from erosion, changes in vegetation, and potential vandalism as a result of increased visitation. Indirect physical effects to resources can include deterioration of structures or rock art from vibration, dust, or exhaust produced by construction or operation. Erosion and changes to vegetation that result from off-site construction can change the characteristics and integrity of a site. If the setting and feeling of a site are essential elements of its importance, visual or auditory intrusions or deterioration of the local environment would also be indirect effects to the aesthetic quality of the site. An additional potential indirect effect results when development of CBM and access roads makes some areas more accessible to off-highway vehicles.

This accessibility results in the potential for more people to visit a site and increases the chance for incidental deterioration or vandalism.

### 3.10.3.1 Effects to Cultural Resource Sites

Potential effects to historic properties from continued CBM development in the Northern San Juan Basin would include destruction and deterioration of prehistoric and historical objects, structures, buildings, sites, districts, and cultural landscapes that represent the patterns, traditions, and achievements of human societies in this region. These effects would result from development and operation of CBM facilities and from incidental or ancillary activities that are associated with development and operation.

Historic properties are nonrenewable resources, and they lose integrity, heritage value, and potentially important information if they are destroyed or altered. Destruction of historical and archaeological sites is irreversible. Treatments to minimize or mitigate adverse effects to historic properties can include project relocation, stabilization, restoration, rehabilitation, repair, or data recovery. Any treatment of a historic property must be consistent with federal standards and other guidelines.

The comparison among alternatives of new disturbance by surface ownership is a general reflection of the potential disturbance to cultural resource sites. For this analysis, it is assumed that federal responsibilities for Section 106 compliance generally will not apply to state and private lands and lands outside the Project Area. However, Section 106 compliance will apply to these lands when the project involves federal minerals, when access to private minerals involves federal land, and when the area of potential effect extends outside the Project Area boundaries. Federal responsibilities for Section 106 compliance are far less on non-federal land for private minerals than on non-federal land for federal minerals. Landowner permission is needed to conduct Section 106 compliance work on state and private lands. Landowner refusal to conduct this work does not preclude the federal agency from denying the permit for the project. In all cases, the federal agency will work diligently and cooperatively with the landowners to fulfill the Section 106 compliance responsibilities.

Table 3–122 presents the estimated areal extent of new surface disturbance by surface ownership for each alternative. It also lists the ratio of new disturbance for each surface ownership to the acreage that would be disturbed by Alternative 5, the No Action alternative. These acreages and ratios represent the proportions of new surface disturbance among the alternatives so that the extent of potential impacts can be compared. If all of the areas of new disturbance among alternatives were comparable, these ratios would represent the proportions of historic properties that might be encountered by each of the proposed development scenarios. Using an average of 10.6 cultural resource sites per section (640 acres) and a proportional average of 30 percent (or 3 of the more than 10) of the sites as historic properties eligible for the National Register, all of the project alternatives could result in some level of impacts to historic properties. All federal undertakings will be subject to Section 106 review under the implementing regulations of the National Historic Preservation Act. The preferred treatment of historic properties for federal undertakings is avoidance and protection. The area of anticipated new disturbance for each alternative is discussed below to compare the alternatives.

## Table 3–122 Relative Areas of New Surface Disturbance by Alternative

| Surface Owner | Total New Disturbance (acres) | Ratio to Alternative 5 (Alt. 5 = 1.00) |
|---|---|---|
| Alternative 1 | | |
| BLM | 31 | na |
| FS | 722 | 7.9 |
| State | 22 | 1.2 |
| Private | 241 | 1.0 |
| Outside Project | 7 | 2.3 |
| Total/Overall Ratio | 1023 | 2.8 |
| Alternative 1A | | |
| BLM | 31 | na |
| FS | 575 | 6.3 |
| State | 21 | 1.1 |
| Private | 241 | 1.0 |
| Outside Project | 7 | 2.3 |
| Total/Overall Ratio | 875 | 2.4 |
| Alternative 1B | | |
| BLM | 31 | na |
| FS | 356 | 3.9 |
| State | 13 | 0.7 |
| Private | 233 | 0.9 |
| Outside Project | 4 | 1.3 |
| Total/Overall Ratio | 637 | 1.7 |
| Alternative 2 | | |
| BLM | 61 | na |
| FS | 1,145 | 12.6 |
| State | 42 | 2.2 |
| Private | 497 | 2.0 |
| Outside Project | 7 | 2.3 |
| Total/Overall Ratio | 1,752 | 4.8 |
| Alternative 3 | | |
| BLM | 31 | na |
| FS | 402 | 4.4 |
| State | 24 | 1.3 |
| Private | 239 | 1.0 |
| Outside Project | 7 | 2.3 |
| Total/Overall Ratio | 703 | 1.9 |
| Alternative 4 | | |
| BLM | 31 | na |
| FS | 419 | 4.6 |
| State | 16 | 0.8 |
| Private | 245 | 1.0 |
| Outside Project | 7 | 2.3 |
| Total/Overall Ratio | 718 | 2.0 |
| Alternative 5 | | |
| BLM | 0 | 1.0 |
| FS | 91 | 1.0 |
| State | 19 | 1.0 |
| Private | 251 | 1.0 |
| Outside Project | 3 | 1.0 |
| Total/Overall Ratio | 364 | 1.0 |

Note:

1. As a result of rounding conventions, total for each alternative can be less than the sum of the values for each surface owner.
2. na is used here because dividing by 0 (total new disturbance) does not yield a ratio.

### 3.10.3.1.1 Alternative 1 — Proposed Action

This alternative will disturb 2.8 times as much new area and 8.3 times as much federal (BLM and FS) surface as Alternative 5. Based on the information from past investigations and known sites in the OAHP Cultural Resource Survey database, approximately four historic properties on federal surface may be affected and, therefore, may need to be considered in project development. Measures can be implemented to avoid the impacts for the majority of the properties under federal jurisdiction.

Twenty-four percent of the proposed areas of surface disturbance will be federal actions subject to Section 106 review. Some actions on private surface may also be subject to Section 106 review.

Construction and operation of new facilities may also increase traffic in the Project Area and facilitate access for people who are not associated with the project. This increased access may result in cumulative deterioration of historic properties. However, mitigation measures would be implemented to restrict public use of the expanded road system by gating roads and restricting public use to selected routes only. These routes are identified in the Recreation Section of this chapter.

### 3.10.3.1.2 Alternative 1A

The overall number of well pads would be less than for Alternative 1. However, some well pads would be larger, and well pads for multiple downhole locations may require individual compressors for each well. Consequently, there may be fewer total wells. The alternative will disturb 2.4 times as much new area and 6.7 times as much federal surface as Alternative 5. The total area of new surface disturbance for Alternative 1A is expected to be 14 percent less than for Alternative 1. The horizontal drilling will be on federal surface. Therefore, the total surface disturbance on federal surface will be 20 percent less than Alternative 1. Approximately three historic properties may be affected by this alternative.

### 3.10.3.1.3 Alternative 1B

Where horizontal drilling is used, a single 4-acre pad would reach multiple downhole target locations. The locations of pads are dictated by constraints on access roads. Although surface disturbance will be avoided in certain sensitive areas, the area of disturbance of some well locations will be greater. The alternative will disturb 1.7 times as much area and 4.3 times as much federal surface as Alternative 5. The total area of new surface disturbance for Alternative 1B is expected to be 38 percent less than for Alternative 1. The horizontal drilling will occur on federal surface. The total federal surface disturbance will be 49 percent less than Alternative 1. Approximately two historic properties may be affected by this alternative.

### 3.10.3.1.4 Alternative 2

Alternative 2 would affect 4.8 times as much total new surface and 13.3 times as much federal surface as Alternative 5. Measures can be implemented to avoid effects for the majority of historic properties under federal jurisdiction. Sixty-nine percent of the proposed areas of surface disturbance will be federal actions subject to Section 106 review. Some actions on private surface may also be subject to Section 106 review. If it is assumed that historic properties are evenly distributed across the landscape, approximately six historic properties on federal surface may be affected.

#### 3.10.3.1.5 Alternative 3

The total area of new disturbance would be 1.9 times that of Alternative 5, and the new disturbance on federal surface would be 4.7 times that of Alternative 5. Sixty-two percent of the proposed areas of surface disturbance will be federal actions subject to Section 106 review. Some actions on private surface may also be subject to Section 106 review. Approximately two historic properties on federal lands may be affected.

#### 3.10.3.1.6 Alternative 4

Alternative 4 may affect 2 times as much total surface and 4.9 times as much federal surface as Alternative 5. Sixty-three percent of the proposed areas of surface disturbance will be federal actions subject to Section 106 review. Some actions on private surface may also be subject to Section 106 review. Approximately two historic properties on federal lands may be affected.

#### 3.10.3.1.7 Alternative 5 — No Action

The majority of sites that may be affected by Alternative 5 would be on private lands and would not be subject to Section 106 review. The effects projected for Alternative 5, the No Action Alternative, are common to all alternatives. The effects to historic properties would most likely occur on private land. In these cases, the private surface owner would have the final decision on treatment of historic properties. Up to one historic property on federal lands may be affected.

## 3.10.4 Cumulative Effects

The Advisory Council on Historic Preservation regulations implementing Section 106 of the National Historic Preservation Act (36 CFR 800) include a definition of adverse effect with respect to cumulative effects on significant historic properties. Adverse effects include reasonably foreseeable effects caused by the preferred alternative that would occur later in time, that would be farther removed in distance, or that would be cumulative (36 CFR 800.5). A determination of no adverse effect means that there is an effect, but the effect would not diminish in any way the characteristics of the cultural resource that qualify it for the National Register.

The sections above address each alternative and the total number of cultural resource sites that may potentially be directly affected by the extent of proposed surface disturbance. All federal undertakings will be subject to Section 106 review. Based on the proportion of known sites that are listed on or considered eligible for the National Register, about 30 percent of the cultural resource sites that may be affected will be historic properties. The potential adverse effects to these properties cannot be derived from the database or existing records, but must be identified in the field. Plus, additional work will be required on some historic properties after the initial inventory to complete National Register evaluations and to confirm their boundaries.

When other large-scale projects in the region with the potential to impact cultural resource sites, traditional cultural properties, and area of traditional use, such as the Tiffany Enhanced Coalbed Methane Recovery Project, the TransColorado Gas Pipeline Project, the Animas-La Plata Project, and improvements to State Road 550 and U.S. Highway 160, are taken into consideration, the cumulative number of cultural resource sites that may be affected could approach 2,000 (BLM 1996; Reed at al. 1992; Chenault 1996). An uncounted number of cultural resource sites were undoubtedly lost to development prior to regulatory protection in the 1970s. Assuming that 30 percent of the known sites may be historic properties, there is the potential for 600 significant cultural resource sites, traditional cultural properties, and areas of traditional use to experience adverse effects. It must be noted that this number includes only known sites in areas that have been inventoried; much of the acreage within and surrounding the Project Area has not been inventoried.

In oil and gas development, avoidance and protection are the preferred mitigation measures for historic properties, and it will be feasible to avoid and protect the majority of historic properties. Well field development also would improve access to the vicinity of some historic properties, increase traffic and activities near cultural resource sites, and increase the potential for inadvertent effects from unrelated activities. The combination of past, present, and reasonably foreseeable oil and gas leasing, other recent and planned projects in the region, plus the increase in the number of visitors to the area, will incrementally increase the cumulative effects to historic properties.

## 3.10.5 Mitigation and Monitoring

All areas of proposed ground disturbance for federal actions will be intensively (Class III) inventoried for cultural resources at the APD, or Sundry Notice phase of each proposed federal action. Current BLM and FS lease stipulations require cultural resource inventory and avoidance and protection or mitigation of impacts to cultural resource values. A programmatic agreement and cultural resource management plan is being developed by the BLM and FS in consultation with the SHPO, the Advisory Council on Historic Preservation, and other consulting parties to be determined, based on input received during ongoing consultations. The management plan will identify project-specific treatment strategies that meet federal and statewide standards. All cultural resource sites that could be affected by the proposed project must be evaluated for eligibility to the National Register.

Specific treatment plans to mitigate the adverse effects to historic properties will be identified and completed prior to project implementation. Treatment plans will be developed in consultation with the SHPO, other consulting parties identified in the Programmatic Agreement, and, if applicable, the private surface owner. These plans might include, but are not limited to, the following mitigation measures, which will be funded by the Companies unless otherwise stated.

- Relocation, redesign, or constraint of project facilities and infrastructure to avoid or minimize earth disturbance within historic properties or contributing portions of historic properties, or to avoid or minimize indirect effects or intrusions caused by vibration, dust, exhaust, or noise. These measures may include barricading or fencing sensitive areas and buffer zones.

- Relocation, redesign, or constraints on project facilities and infrastructure to avoid or minimize visual intrusion on a sensitive historic property, traditional cultural property, or area of traditional use. This action might include low-profile facilities, nonintrusive colors, landscaping, berms, screening with vegetation, or other measures to minimize visual impact.
- Stabilization of sediments, bedrock, or structures that could be destabilized or could deteriorate as a result of nearby development or traffic, and identification of an appropriate buffer zone.
- Restriction on or prevention of access to sensitive areas.
- Rehabilitation of buildings or structures or protective screening of artwork to minimize deterioration.
- Detailed documentation, possibly including archival photodocumentation, of contributing structures, landscape features, or aspects of the historic setting that cannot feasibly be avoided. In some cases, it may be feasible to restore some of these contributing features after construction has been completed.
- Detailed recordation or data recovery of the essential contributing elements of a historic property that cannot be avoided or protected. Recordation may include archival, documentary, and contextual research related to the historic property, in addition to site documentation. Data recovery is the systematic recovery of data important in history or prehistory for which the property is considered eligible. Data recovery for prehistoric or historic archaeological sites typically entails excavation of buried materials and detailed documentation of stratigraphic context.
- Intensive (Class III) inventories may not identify all historic properties in an APE because various natural conditions can hinder the discovery process. Unanticipated discoveries are undocumented cultural resources and human remains that are encountered during construction or operation of facilities. If unanticipated discoveries are made in connection with operations, the project proponent will immediately suspend all operations in the vicinity of the find and cannot resume until the discovery is appropriately treated and authorization is given by the federal agency.
- If human remains are encountered on federal land, the federal agency must follow the Native American Graves Protection and Repatriation Act (25 U.S.C. 3001) and its implementing regulations. Pursuant to 43CFR10.4(g), the authorized officer must be notified, by telephone, with written confirmation, immediately upon the discovery of human remains, funerary items, sacred objects, or objects of cultural patrimony. Furthermore, pursuant to 43CFR10.4 (c) and (d), activities must stop in the vicinity of the discovery and the discovery must be protected for 30 days or until notified to proceed by the authorized officer.
- If human remains are encountered on state or private lands, all work near the discovery will be stopped immediately in accordance with Colorado Revised Statutes (CRS) 24-80-1302 and local authorities (for example, county sheriff or coroner) will be contacted. The local authorities will cooperate with the operator to determine whether the human remains are recent and of forensic concern, or whether they are historic or prehistoric

in nature. If the human remains are determined to be historic or prehistoric, a qualified archaeological contractor will consult with the State Archaeologist to prepare a treatment plan for the human remains. This treatment plan will include provisions to identify lineal descendants or culturally affiliated persons. Construction or operation of facilities will resume in the area of discovery only under the stipulations of the treatment plan or after the treatment plan has been satisfactorily completed.

## 3.10.6 Conformance to Existing Plans and Policies

The goals for cultural resource sites in the 1984 Resource Management Plan for the BLM San Juan and San Miguel Planning Areas emphasize avoidance and protection of important cultural resource sites through positive actions. Several specific cultural resource areas are discussed under each alternative for the development of area-specific management plans and protective stipulations. However, all of the areas are west of the Project Area in Dolores, Montezuma, and Montrose Counties. The stated goals and objectives are not tied to the types or numbers of cultural resource sites that may be affected. All areas of potential effect will be inventoried for cultural resource sites, and treatment of those resources will comply with Section 106 of the National Historic Preservation Act. Preferred management strategies are avoidance and protection. Therefore, all alternatives will conform equally to the Resource Management Plan.

The San Juan National Forest Land and Resource Management Plan places a similar emphasis on avoidance and protection of all cultural resource sites. However, the FS includes mitigation measures or development for recreation and nonrecreation use as options for the protection of sites. National Register resources within or near the project area named in the management plan are the Durango and Silverton Railroad, the Spring Creek Archaeological District, and the Chimney Rock Archaeological Area. All areas of potential effect will be inventoried for cultural resources, and treatment of these resources will comply with Section 106 of the National Historic Preservation Act. Preferred management strategies are avoidance and protection. Therefore, all alternatives will conform equally to the Land and Resource Management Plan.

## 3.10.7 Unavoidable Adverse Effects

The Advisory Council on Historic Preservation regulations implementing Section 106 of the National Historic Preservation Act (36 CFR 800) require a determination of either adverse effect or no adverse effect for potentially affected National Register-eligible cultural resources. An adverse effect occurs when an impact alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for the National Register. Adverse effects include reasonably foreseeable effects caused by the preferred alternative that would occur later in time, that would be farther removed in distance, or that would be cumulative (36 CFR 800.5). A determination of no adverse effect means that there is an effect, but the effect would not diminish in any way the characteristics of the cultural resource that qualify it for the National Register.

Because avoidance of cultural resource sites is the preferred mitigation measure, most direct effects can be avoided. Relocation of project elements can avoid destruction of cultural resource sites. Restriction of access to sensitive areas can reduce indirect effects to cultural resource sites, traditional cultural areas, and areas of traditional use, such as vandalism. However, some unavoidable indirect effects may still occur. For example, vibration can impact architectural remains by shaking fragile walls; dust and exhaust from construction vehicles can coat and erode architectural structures; noise from construction activities can impinge on areas of traditional use; and construction and operation of facilities can cause visual intrusions on traditional cultural properties and areas of traditional use.

Under the proposed action and other action alternatives, new surface disturbance will occur to varying degrees. Therefore, there is the potential for unavoidable adverse effects to cultural resource sites, traditional cultural properties, and areas of traditional use. As project implementation proceeds and well pad and infrastructure locations are proposed, site-specific information will be gathered through literature searches and intensive (Class III) inventories to identify potential unavoidable adverse effects to cultural resource sites. Mitigation measures can then be implemented to minimize unavoidable adverse effects.

## 3.10.8 Irreversible and Irretrievable Effects

An irreversible or irretrievable commitment of resources would occur when resources are lost as a result of the project. The loss would be irreversible if the project started a process that could not be stopped. For example, if vibration destabilized the fragile walls of an architectural structure, the process of collapse of the walls would be irreversible without stabilization efforts. Commitment of a cultural resource would be considered irretrievable if the project would directly or indirectly eliminate the cultural resource site, traditional cultural property, or area of traditional use.

Under the proposed action and other action alternatives, there could be indirect irreversible effects on cultural resource sites, traditional cultural properties, and areas of traditional use. Site-specific files searches and intensive (Class III) inventories will identify indirect effects that could be irreversible. The goal of management strategies is avoidance of all cultural resource sites, traditional cultural properties, and areas of traditional use. If avoidance were not possible, mitigation measures would be implemented to prevent the total loss of sites and traditional and scientific information. Therefore, there should be no direct irretrievable effects. Under the no action alternative, there would be no irreversible and irretrievable effects.

# 3.11 Land Use

## 3.11.1 Issues

*Issue 7: The effects of additional CBM development on agricultural and residential land uses.*

- Is the proposed project consistent with the adopted land use plans and policies of federal, state, and local agencies?
- How will CBM affect existing land use, agriculture, and livestock/range conditions?
- How do private property owners participate in the development of surface use plans designed to protect surface resources?

*Issue 17: The effects of additional development on the HD Inventoried Roadless Area and roadless lands in general.*

- How will CBM development affect the Archuleta Mesas portion of the Project Area?

## 3.11.2 Affected Environment

### 3.11.2.1 Ownership

The Project Area encompasses 125,000 acres of land (195 square miles). Most of the surface in the Project Area is privately owned (Table 3–123). The federal government owns almost 45 percent of the surface area, and the State of Colorado owns a small portion of the surface in the Project Area.

**Table 3–123 Distribution of Surface Ownership by Owner and County**

| Surface Ownership | Area by County | | Extent (acres) | Portion of Project Area (percent) |
|---|---|---|---|---|
| | La Plata (acres) | Archuleta (acres) | | |
| Federal BLM | 6,681 | 0 | 56,090 | 45 |
| Federal NFS | 20,013 | 29,396 | | |
| State | 4,101 | 362 | 4,463 | 4 |
| Private | 60,507 | 4,334 | 64,841 | 51 |
| Total | 92,302 | 34,092 | 125,394 | 100 |

The pattern of surface ownership is distinctly different in the western and eastern portions of the Project Area. Surface ownership in the western half of the Project Area consists primarily of private property intermingled with federal (BLM) and state lands (Figure 3–37). The BLM San Juan Center administers the federal lands within the San Juan/San Miguel Planning Area. The eastern half of the Project Area is mostly federal land within the SJNF, administered by the FS Columbine Ranger District.

Overall, the pattern of mineral ownership is similar to surface ownership, except that the federal and private categories are reversed (Table 3–124). About 46 percent of the mineral estate is privately owned, and 50 percent of the mineral estate within the Project Area is federally owned. Most of the privately owned mineral estate is in the western portion of the Project Area Figure 3–38). BLM manages the federal mineral estate for both BLM and NFS lands. Therefore, 50 percent of the mineral estate within the Project Area is under BLM's jurisdiction.

**Table 3–124 Classes of Mineral Ownership in the Project Area**

| Surface/Mineral Jurisdiction | Acres | Percent of Mineral Ownership | |
|---|---|---|---|
| BLM Surface/Federal Mineral | 6,658 | Federal | 50 |
| National Forest Surface/Federal Mineral | 47,373 | | |
| Private Surface/Federal Mineral | 8,567 | | |
| Private Surface/Private Mineral | 56,253 | Private | 46 |
| Federal Surface/Private Mineral | 2,034 | | |
| State Surface/State Mineral | 4,459 | State | 4 |
| Total | 125,394 | | 100 |

Six classes of mineral and land ownership occur within the Project Area, as shown on Figure 3–38 and summarized on Table 3–124. Some of the properties within the Project Area are "split estate," meaning that the owners of the surface and mineral rights are different. For example, the surface may be privately owned, but the mineral estate is federally owned.

## 3.11.2.2 Existing Land Uses

Existing land uses within the Project Area were mapped using information from La Plata and Archuleta Counties. Figure 3–39 shows the distribution of the categories of primary land use identified in the Project Area, and Table 3–125 shows the areal extent of each category. The predominant land uses within the Project Area are agricultural/rangeland and undeveloped lands. Undeveloped lands include federal or state lands that are generally available for rangeland, dispersed recreation, timber management, and mineral leases. The primary transportation corridors within the Project Area are discussed in the Transportation section of this chapter.

### *3.11.2.2.1 Undeveloped Land*

Undeveloped areas within the Project Area consist primarily of federal lands and, to a lesser extent, some state open lands are also in this category. The BLM and NFS lands are managed for multiple uses, including such concurrent uses as rangeland under permitted grazing allotments, dispersed recreation, timber management, and mineral development.

Approximately 53 percent of the Project Area is currently in the undeveloped land use category. Most of the undeveloped land in Archuleta County is within the SJNF, and almost half of this undeveloped land is used as rangeland under permitted grazing allotments (FS 1982). The BLM and NFS lands in La Plata County are also included in the undeveloped land use category.

Table 3–125 Areal Extent of Existing Land Uses in the Project Area

| Category of Land Use | Areal Extent: La Plata County (acres) | Areal Extent: Archuleta County (acres) | Areal Extent: Project Area (acres) | Portion of Project Area (Percent) |
|---|---|---|---|---|
| Undeveloped[1] | 32,964 | 34,028 | 66,992 | 53.4 |
| Agriculture/Rangeland | 31,190 | 44 | 31,234 | 24.9 |
| Residential | 25,364 | NA[2] | 25,364 | 20.2 |
| Urban | 1,758 | NA | 1,758 | 1.4 |
| Total[3] | 91,276 | 34,072 | 125,394 | 100.0 |

Notes:
1. Undeveloped federal lands (BLM and NFS) are generally used as rangeland under permitted grazing allotments, and for dispersed recreation.
2. NA = not available.
3. Totals may not match precisely with values obtained by adding unit numbers because of rounding conventions.

Dispersed recreation is emphasized in the Grandview Ridge and Horse Gulch Trails area, located primarily on BLM lands in La Plata County, and in several county open space and recreational areas.

### *3.11.2.2.2 Agriculture/Rangeland*

The agriculture/rangeland category of land use includes both farmland used for producing crops and rangeland used for grazing livestock. It also includes some rural residential properties.

The agriculture/rangeland category encompasses 25 percent of the Project Area (Table 3–125). Within the Project Area, most of the land in this category is rangeland used for grazing livestock. The rest of the agricultural land is used as farmland for producing crops.

A small portion of the farmland in the Project Area is considered prime farmland. The prime farmland designation is based on soil type, regardless of current land use. The prime farmlands in the Project Area are composed of irrigated soils in a small area along the upper section of the Florida River and near Bayfield. Impacts to date that have affected prime farmlands are discussed in the Soils section of this chapter.

The BLM and NFS lands in the Project Area are generally available as rangeland for livestock under permitted grazing allotments. A grazing allotment is an area of land designated and managed for the grazing of livestock by one or more livestock operators. The number of livestock (stocking rate or carrying capacity) and period of use are stipulated for each allotment. The carrying capacity is an estimate of the maximum number of animals (expressed in Animal Unit Months [AUMs]) a given area can support each year without damage to vegetation or related resources. One AUM is the amount of forage necessary to support one animal-unit for one month. An animal-unit is a 1,000-pound cow typically consuming 780 pounds of air-dry forage for one month.

Grazing allotments are managed and multiple land uses are coordinated to maintain healthy public lands. The San Juan/San Miguel Planning Area RMP and amended RMP (BLM 1985, 1991), and the Decision Record for the Standards for Public Land Health and Guidelines for Livestock Grazing Management (BLM 1997) apply to development on BLM lands. The standards and guidelines for the NFS lands in the Project Area are provided in the SJNF LRMP and amended LRMP (FS 1982, 1992). These standards and guidelines are also discussed in the Vegetation section of this chapter.

The Project Area contains entire, or portions of, 7 BLM grazing allotments and 10 Forest Service grazing allotments (Figure 3–40). Livestock grazing is permitted on 5 of 7 BLM allotments and 7 of 10 FS allotments. On BLM lands, 300 AUMs are permitted for livestock grazing and on NFS Lands, 2,899 AUMs are permitted. Table 3–126 displays permitted use and grazing allotment management. Grazing is permitted on approximately 68 percent of public lands within the Project Area. Due to the steep, rugged terrain, livestock can graze only about 35 percent of NFS lands within the Project Area. BLM lands are generally more accessible within the Project Area.

**Table 3–126 Affected Grazing Allotments within the Project Area**

| Allotment | Owner | Status | Areal Extent (acres) | Permitted AUM[1]s | Grazing Season | Management |
|---|---|---|---|---|---|---|
| Palmer | BLM | Vacant | 745 | 0 | na[2] | na |
| Florida River | BLM | Active | 847 | 102 | 3/1 – 2/28 | Season-long |
| W. Rabbit Mtn. | BLM | Active | 160 | 21 | 6/1 - 10/31 | Season-long |
| Wallace Gulch | BLM | Vacant | 1,847 | 0 | na | na |
| North Canby | BLM | Active | 40 | 6 | 5/16 – 6/30 | Season-long |
| Mahan | BLM | Active | 1,120 | 161 | 6/1 – 9/30 | Season-long |
| South Canby | BLM | Active | 86 | 6 | 6/1 - 10/30 | Season-long |
| Little Bear | FS | Active | 3,237 | 57 | 5/16 – 6/15 | Rotational |
| Shaefer Mtn. | FS | Vacant | 3,413 | 0 | na | na |
| Bonnell Cyn. | FS | Active | 6,142 | 121 | 6/2 – 10/15 | Rotational |
| Sauls Creek | FS | Active | 13,595 | 395 | 5/16 – 6/30 | Rest-Rotation |
| HD | FS | Active | 22,087 | 506 | 5/21 – 6/25 and 10/6 – 10/12 | Rest-Rotation |
| Mosca | FS | Active | 15,034 | 1200 | 6/26 – 10/5 | Rotational |
| Freeman Creek | FS | Active | 13,826 | 455 | 6/1 – 10/15 and 10/16 – 10/30 | Rotational |
| Turkey | FS | Active | 12,185 | 165 | 5/16 – 6/30 | Rest-Rotation |
| Turkey Exclosure | FS | Vacant | 14,624 | 0 | na | na |
| Chimney Rock | FS | Vacant | 21,754 | 0 | na | na |
| Total | | | 130,742 | 3,199 | | |

Notes:

1. An animal unit factor of 1.32 is used on NF lands due to the forage demand by an adult cow with offspring.
2. na = not applicable

Grazing management on BLM lands is directed either at maintaining current satisfactory resource conditions or preventing resource deterioration (BLM 1984b). Grazing allotments are generally small and scattered amongst larger private land parcels. Season-long grazing systems are in place. There are no pastures within allotments. With the exception of the Mahan allotment, all BLM grazing allotments contain 100 percent public land ownership. Range conditions are generally fair and estimated trend is stable.

Grazing management on NFS lands is directed at achieving and maintaining satisfactory range conditions. On an individual grazing allotment basis, livestock management is directed at meeting a range of resource objectives including satisfactory riparian conditions, big game winter range, dispersed recreation, and livestock production (FS 1992). Rotational grazing systems, utilizing fences and natural topographical features to separate allotments into pastures, are used to meet grazing management objectives. Range conditions are generally good and trend is stable to improving.

Much of the public land within the Project Area is inaccessible due to steep slopes, poor forage production, and dense brush. Primary range available for grazing is mainly sagebrush grasslands on bottomlands and valleys and secondary range comprised of ponderosa pine forests, pinyon-juniper woodlands, and Gambel oakbrush scrub. Main forage species are: western wheatgrass, Kentucky bluegrass, junegrass, bottlebrush squirreltail, needlegrasses, and brome grasses. Range improvements have included sagebrush clearing and re-seeding, fence construction, cattleguard installation, water developments, and erosion control features (FS and BLM 1992). In addition, other vegetative improvement projects that have been undertaken on public lands include prescribed burning, timber thinning, and hydromowing.

Prior to the establishment of the SJNF, some NFS lands were used for grazing cattle and sheep year round, because of the generally low elevation. After establishment of the SJNF, adjoining ranches continued to use the area for grazing, probably with excessive numbers of animals. In addition, trespass was frequent. Forage depletion and accelerated erosion resulted from overuse of the rangeland. From the 1930s through the present, range conditions have continued to improve in terms of species composition and cover.

The following management practices have been implemented in the SJNF:

- Elimination of season-long grazing and creation of rotation grazing systems,
- Fencing of allotments into pastures to control cattle distribution,
- Developing stock ponds,
- Erosion control structures in some key watersheds,
- Reseeding of depleted areas,
- Prescribed fire to recycle nutrients, and
- Sensitive areas, such as riparian areas, are grazed for short time periods to promote vegetation re-growth, maintain water quality, and improve channel stability.

The allotments in the SJNF are currently managed with rotation grazing systems. Some allotments are used only 30 days in the spring, and others are used the entire season with deferment of pastures during certain periods of the growing season. Stock ponds, herding, salting, fencing, and geographical barriers are the primary means of controlling livestock distribution. The range analysis summaries show an upward trend in terms of species composition and cover.

The management plans for the grazing allotments in the SJNF are to be updated by the year 2008. During these revisions, vegetative analysis will be conducted, and changes in management will be made as deemed necessary. Until that time, only minor changes in response to climatic effects are expected on these allotments

### 3.11.2.2.3 Residential Land

The county-designated land use maps define three categories of residential land use within the Project Area: rural residential, existing subdivisions, and proposed subdivisions. Residential development includes single-family and multi-family dwellings and mobile homes. About 20 percent of the Project Area is classified in residential the land use category (Table 3–125). Some residential land uses are also included within county-designated urban land.

### 3.11.2.2.4 Urban Land

Urban land uses are defined as commercial, public and institutional facilities, industrial facilities, mines, and roads. In addition, the City of Durango has designated several "potential urban areas" within the Project Area that may be provided urban services, such as water and wastewater disposal (Hoch 2003). These areas may be subject to city annexation. These potential urban areas are primarily concentrated in the areas southeast of the city, near the intersection of U.S. Highway 550 and U.S. Highway 160. La Plata County also has designated similar areas around the Town of Bayfield. Mines include several inactive or abandoned coal mines and active sand, gravel, and aggregate mines. This category of land use encompasses only a small portion of the Project Area (Table 3–125).

### 3.11.2.2.5 Existing Oil and Gas Development

The existing oil and gas development shown on Figure 3–39 has displaced some uses through construction of oil and gas facilities in areas that previously supported other types of uses. As of the end of 2002, existing oil and gas facilities had converted a total of 553 acres (just less than 1 percent of the Project Area) to oil and gas facilities. The existing facilities include 323 CBM wells, 13 conventional oil and gas wells, 6 disposal wells, and 4 compressor stations.

Existing CBM wells are not uniformly distributed across the Project Area. Most of the wells (75 percent) are on private lands within La Plata County. More than 54 percent of the wells on private agricultural lands involve lands that are classified as rangeland and are used for grazing livestock and cattle. Less than 1 percent of the wells are on farmlands used for producing crops. About 23 percent of the wells are on private rural residential properties.

The areal extent of impact to the land use categories caused by existing CBM facilities parallels their distribution. For example, existing oil and gas facilities have displaced 267 acres of agricultural land, which is less than 1 percent of the agricultural land present in the Project Area. Oil and gas facilities have displaced less than 80 acres of residential land (1 percent of the residential land in the Project Area).

Many of the existing oil and gas facilities are located along transportation corridors, such as U.S. Highways 160 and 172 between Durango and Ignacio. Some

CBM facilities are visible from corridors that also serve as primary routes for visitors to the area.

## 3.11.2.3 Land Use Plans and Policies

Oil and gas development within the Project Area must comply with the land use plans and policies adopted by federal, state, and county governments. A summary of the applicable current plans and policies is provided in this section.

### 3.11.2.3.1 Federal Land Management

BLM- and FS-administered federal lands are generally available for oil and gas leasing, exploration, and development. The San Juan/San Miguel RMP and EIS and amended RMP (BLM 1984a, 1984b, 1991) and the Colorado Oil and Gas Leasing EIS (BLM 1991) provide guidelines for use of the BLM-administered federal lands and federal mineral estate in the Project Area. The SJNF LRMP (FS 1982) and the amended LRMP (FS 1992) provide guidelines for energy mineral development on the National Forest.

BLM is responsible for issuing and managing leases that involve federal minerals, regardless of surface ownership. BLM is also responsible for conducting an environmental analysis on BLM lands (BLM surface ownership), preparing the documentation, and specifying the mitigation measures to protect surface resources for approval of an APD. The FS responsibilities are similar on NFS lands. BLM is responsible for approval of the drilling program, protection of groundwater and other subsurface resources, and final approval of the APD on both BLM and NFS lands with federal minerals. Within the SJNF, the FS authorizes surface use plans for oil and gas developments.

A COGCC drilling permit is required for wells on private and state mineral estates.

### 3.11.2.3.2 State Land Management

State-owned lands in the Project Area are generally available for mineral and agricultural leasing, timber sales, dispersed recreation, and open space. Land use goals for most of the state lands within the Project Area include oil and gas development. There are no state parks or state wildlife areas within the Project Area.

COGCC rules (COGCC 2002) apply to drilling and operating oil and gas wells on private or state mineral estates. These rules require setbacks with respect to distance of wellheads from lease lines, surface property lines, other producible oil or gas wells, occupied buildings, public roads, major aboveground utilities or railroads, and existing coal mines, unless authorized by order of the COGCC. These setback distances are designed to address safety issues and to minimize potential conflicts between the wells and adjacent land uses.

### 3.11.2.3.3 County and Municipal Planning and Land Use Controls

Local government regulations apply to CBM development on private lands. Oil and gas development on private lands within unincorporated La Plata or

Archuleta Counties must comply with the county land use regulations, as summarized in the following subsections.

### La Plata County

Development on private lands within unincorporated areas of La Plata County must comply with the La Plata County Land Use Code (La Plata County 1997). Although no zoning regulations currently are in place for the portion of the county within the Project Area, the land use code effectively serves as a zoning code and a system for permitting and regulating development in La Plata County. Specifications and standards for development and performance are included in the code. The County is currently evaluating and rewriting the code.

The County also recently developed a draft La Plata County Comprehensive Plan (La Plata County 2001a). The goal of the comprehensive planning process is to provide a County-wide guide to growth using the land use plans established by the planning districts. Proposed projects on private lands that do not conform to the land use classification map of the planning district will require an amendment to the plan.

In 1990, the County added specific regulations to its land use system for both "minor" and "major" oil and gas facilities on private lands (Chapter 90 of the Code, Ordinance No. 2000-32). A "minor" oil and gas facility is "an individual well site built and operated to produce petroleum and/or natural gas (methane), including auxiliary equipment required for production, and other equipment located within the perimeter of the well site pad…" A compressor station is a major oil and gas facility and requires a public hearing before a permit can be approved. Section 90-52 of the code requires that operators submit an Emergency Preparedness Plan.

### Archuleta County

Archuleta County has no jurisdiction over development in most of the Project Area because it is predominantly federal land within the SJNF. Figure 3–37 shows the portion of the Project Area that is NFS land within the SJNF. Very little private land or existing or proposed residential developments are within this area.

Development on private lands in the unincorporated part of the County must comply with the Archuleta County Land Use Regulations and may require a conditional use permit (Archuleta County 2000). These regulations define conditional uses as land development, including mining or extraction that has the potential to cause adverse impacts on other land uses. A conditional use permit is required for major oil and gas facilities. The intent of the conditional use permit process is to ensure that the location and operation of the proposed land use will not be detrimental to other uses or properties (Archuleta County 2000, 2001a).

The current development trends for Archuleta County suggest that no urban growth is likely within the Project Area. Most of the predicted growth, including proposed subdivisions, would be located east of the Project Area near Pagosa Springs.

### *3.11.2.3.4 Surface Land Use Plans and Participation by Private Property Owner*

The landowner has full control over the location of CBM facilities for properties in which the landowner holds surface and mineral rights. Landowners that do not own the mineral rights cannot prevent mineral lessees from drilling a well on the property. However, owners of private lands where mineral rights are owned and controlled by the federal government have opportunities to participate in developing surface use plans through the BLM, FS, and county permitting processes. More than half the lands in La Plata County are split estate with privately owned surface that overlie the Fruitland Formation (Hammer, Silver, George Associates 1990).

BLM must analyze and approve each component of CBM development on a site-specific basis when federal mineral leases are involved. The method used to evaluate each surface-disturbing activity is the APD, ROW Grant, or SUPO, which must be approved before construction can begin. The APD includes a surface use program and a drilling plan, as identified in Onshore Oil and Gas Order No. 1 and at 43 CFR 3162.3. The proposed well, access road, and pipeline locations, and other areas of proposed surface land use are inspected on site before the application can be approved. For split estate lands (land with private surface ownership and federal minerals ownership), the surface owner is invited to attend the on-site inspection and has the opportunity to provide input on where the facilities would be located.

The on-site inspection identifies potentially sensitive areas and the environmental consequences associated with the proposal at each specific location. It focuses on site-specific methods needed to mitigate environmental effects. After the site inspection, the APD may be revised and additional site-specific mitigation added as COAs to the APD, consistent with the terms of the lease, to protect the value of surface or subsurface resources near the proposed activity. These conditions usually include adjusting the proposed locations for well sites, roads, and pipelines; identifying the construction methods to be employed; and establishing additional mitigation and reclamation standards.

Surface use and ROW on private lands must also be approved by state, county, and municipal agencies. Access or surface use agreements are negotiated with surface owners or secured through the permitting processes of the federal, state, or local jurisdictional agencies. Surface owners are generally compensated for the value of split estate lands that are displaced by CBM facilities.

The county land use permit process is designed to minimize impacts from the proposed facilities on private lands within unincorporated portions of La Plata or Archuleta Counties and defines required mitigation measures. A permit for either a minor or major oil and gas facility must be obtained for CBM development on private land within unincorporated La Plata County. The permit application for an oil and gas facility requires the applicant to specify measures to minimize surface damage and degradation of visual resources. A minor oil and gas facility permit is required for an individual CBM well. A major oil and gas permit would be required for a compressor station, and a public hearing is also required.

Development of a major oil or gas facility on private lands in unincorporated Archuleta County requires a conditional use permit. This permit is intended to ensure that the location and operation of the proposed use will not be detrimental to other uses or properties. A public hearing is required for a conditional use permit.

### 3.11.2.3.5 Unroaded Lands within the Project Area

A portion of the NFS lands in the Project Area are in the HD Mountains and are defined as unroaded lands (Figure 2–2). The HD Mountains Roadless Area (RARE II designation) forms the core of the HD Mountains portion of the Project Area. The official Inventoried Roadless Area is approximately 20,010 acres in size and was delineated using roadless criteria established through the 1979 Roadless Area Review and Evaluation (RARE). The FS has reinventoried the Project Area to determine if there are any changes over the past 25 years. The criteria used to make this redetermination are somewhat different from the original inventory. Now, unclassified roads can be included in unroaded area, whereas during RARE, the presence of classified and unclassified roads excluded areas from roadless designation. A total of 27,796 acres of unroaded area are now delineated as unroaded lands based on the physical characteristics of the land and the current transportation system (Figure 3–48). The 27,796-acre unroaded area presents a boundary that is somewhat different than the original roadless area boundary. Each of the alternatives would impact unroaded land within the Project Area. Most of the unroaded area is leased for energy mineral development.

The unroaded area provides a variety of uses including dispersed recreation, primarily hunting, all-terrain vehicle (ATV) use, camping (generally associated with hunting), sightseeing, and fishing. Seasonal big game hunting is the major attraction to the HD Mountains Area. There are two CBM wells in the HD Mountains Roadless Area and a Forest Service system road (FSR 756) that splits the Roadless Area, providing access to an existing gas well, a stock driveway, and the top of the HD Mountains.

The 1979 RARE II recommended continued management of HD Mountains Inventoried Roadless Area for non-wilderness, multiple use activities. The 1983 Record of Decision for the LRMP for the SJNF continued the theme of managing the HD Mountains Roadless Area for multiple-uses including oil and gas development.

The following chronology summarizes the timing and status of land management decisions relevant to the HD's Roadless Area:

- Early 1970s – USGS identifies the San Juan Basin as having high potential for oil and gas development including the HD Mountains.
- 1974–77 – Large portions of the HD Mountains are leased for oil and gas development.
- 1977–79 – RARE II identifies 20,010 acres of the HD Mountains as an Inventoried Roadless Area. Oil and gas leases issued during this period are issued with No Surface Occupancy stipulations.

- 1979 – RARE II recommends that the HD Mountains Inventoried Roadless Area not be included in the National Wilderness Preservation System.
- 1980 – The Colorado Wilderness Act does not include the HD Mountains Roadless Area in the National Wilderness Preservation System
- 1980 – The Energy Security Act directs the Secretary of Agriculture to process leases on National Forest System lands regardless of the status of any ongoing planning efforts.
- 1981 – The No Surface Occupancy stipulations are rescinded for leases issued during the RARE II evaluation process.
- 1983 – The Record of Decision for the Land and Resource Management Plan for the San Juan National Forest reaffirms that the HD Mountains are available for multiple uses other than wilderness.
- 1992 – The Environmental Impact Statement for the HD Mountains Coalbed Methane Gas Field Development Project analyzes development of 95 coal bed methane gas wells. The Record of Decision approves Applications for Permit to Drill for 16 wells and associated facilities and establishes a programmatic gas field development plan that would develop portions of the HD Mountains Roadless Area.
- 1993 – The Colorado Wilderness Act of 1993 designates certain lands within the SJNF for inclusion into the National Wilderness Preservation System. The HD Mountains Roadless Area is not included in the Act.
- 2001 – The "Final" Roadless Area Conservation Rule is adopted. It recognizes the prior existing right of lessees to develop oil and gas resources under existing leases, including road building.
- 2003 – The District Court for the State of Wyoming permanently enjoins the Roadless Conservation Rule. The Rule would have affected two leases issued in the HD Mountains Roadless Area after January 12, 2001 with NSO Stipulations. The NSO stipulations would have been non-waivable under the provisions of the rule.

#### 3.11.2.3.6 Archuleta Mesas — Potential Research Natural Area

The Archuleta Mesas area includes lands that were formerly referred to as Archuleta Creek and Deep Canyon. The Deep Creek area is also in the Archuleta Mesas area and is south of Chimney Rock and east of the Piedra River in the far eastern portion of the Project Area. The FS has identified Deep Creek as one of a number of areas to be evaluated through the San Juan NF's LRMP revision process for possible research natural area (RNA) recommendation. The LRMP revision process began in October 2003 and is expected to be completed in 2005.

The BLM issued the Deep Creek lease COC-64932 (1,680 acres) in May 2001 with a no-surface occupancy stipulation to remain in effect pending completion of the LRMP revision. If the Deep Creek area is recommended for inclusion in the RNA system, the NSO will continue. If not recommended, the Forest Service and BLM would evaluate continuation of the NSO on a site-specific basis when notice of staking or application for permit to drill is submitted.

## 3.11.3 Environmental Consequences

This section analyzes how the alternatives may affect existing land uses within the Project Area and whether the project would be consistent with the land use plans and policies adopted by the federal, state, and local jurisdictions.

### 3.11.3.1 Land Use

The proposed CBM development would affect existing land uses in the Project Area in several ways. First, some existing land uses would be displaced by surface disturbances during both the construction and operation phases of the project. These impacts would occur for the life of the project.

Second, land uses near CBM facilities would be affected by intrusive effects. For example, CBM-related vehicles on existing roads would generate additional noise, dust, and traffic. These effects may conflict with nearby land uses, primarily residential properties.

Third, the proposed CBM facilities may affect growth patterns, possibly resulting in conflicts with county goals for future land use. Impacts to visual resources, noise, dust, recreation, transportation, and potential effects to residential property values are analyzed in other sections of this chapter.

The distribution of proposed CBM facilities across the categories of land uses is shown on Figure 3–41. The number of proposed CBM wells within each land use category is listed in Table 3–127. Most of the proposed CBM wells would be located on undeveloped land, a county-designated land use category. This category consists primarily of federal lands (BLM and FS). In addition, some State open lands are in this category. Most of the undeveloped land in Archuleta County is within the SJNF and available as rangeland for livestock under permitted grazing allotments.

Land use impacts would vary depending on surface and mineral ownership at the specific locations of CBM facilities. Landowners who own the mineral rights for the property are able to decide whether to allow CBM development on the land. The landowner has full control over the location of CBM facilities for properties with both surface and mineral rights.

Land use conflicts are most likely to occur where CBM wells are located on split estate properties that have private surface ownership without mineral estate ownership (severed minerals). In some cases, landowners are not aware of the severed mineral rights until they receive a notice that the lessee intends to drill a well on the property. The specific locations for CBM facilities would be negotiated with landowners on split estate lands. Surface owners would generally be compensated for the value of land displaced by CBM facilities. However, there have been conflicts between some surface and mineral estate owners over the adequacy of compensation. There most likely will be additional disagreement as CBM development proceeds on private land.

**Table 3–127 New CBM Wells by Land Use Category and Alternative**

| Land Use Category | Number of New CBM Wells by Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Undeveloped | 212 | 198 | 147 | 373 | 128 | 103 | 30 |
| Agricultural | | | | | | | |
| Rangeland | 28 | 28 | 28 | 59 | 28 | 27 | 29 |
| Farmland | 17 | 17 | 17 | 23 | 16 | 16 | 16 |
| Residential | | | | | | | |
| Rural Residential | 11 | 12 | 11 | 13 | 11 | 11 | 10 |
| Existing Subdivision | 14 | 14 | 14 | 28 | 13 | 14 | 19 |
| Proposed Subdivision | 10 | 10 | 10 | 22 | 12 | 11 | 10 |
| Urban and Roads | 4 | 4 | 4 | 4 | 4 | 3 | 3 |
| Total | 296 | 283 | 231 | 522 | 212 | 185 | 117 |
| Total No. of Well Pads | 273 | 221 | 158 | 499 | 212 | 185 | 117 |

A limited number of CBM facilities are proposed on split-estate properties with private surface ownership. All of the proposed wells on split-estate lands with private surface ownership are located in La Plata County. No CBM facilities are proposed on private split-estate properties in Archuleta County. Table 3–128 shows the number of proposed CBM wells to be located on split-estate properties by land use category.

**Table 3–128 New CBM Wells on Private Split Estate Land, by Alternative**

| Land Use Category | Number of New CBM Wells by Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Undeveloped | 1 | 1 | 1 | 2 | 5 | 5 | 0 |
| Agricultural | | | | | | | |
| Rangeland | 5 | 5 | 5 | 7 | 6 | 6 | 6 |
| Farmland | 6 | 6 | 6 | 16 | 0 | 0 | 0 |
| Residential | | | | | | | |
| Rural Residential | 0 | 0 | 0 | 0 | 1 | 2 | 1 |
| Existing Subdivision | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| Proposed Subdivision | 2 | 2 | 2 | 5 | 0 | 0 | 0 |
| Urban and Roads | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Undeveloped | 0 | 0 | 0 | 0 | 14 | 15 | 9 |
| Total | 15 | 15 | 15 | 31 | 3 | 4 | 5 |

There are two main environmental consequences affecting grazing management as proposed in the action alternatives: Temporary loss of available forage for livestock, as expressed in the short-term (0 to 10 years) and long-term (11 to 30 years), and impacts to natural boundaries due to road and ancillary facility construction. As road and other facility locations are proposed, it is difficult to determine how many miles of fence would be needed to mitigate the loss of natural pasture and allotment boundaries. Therefore, these impacts will need to be mitigated on an allotment-by-allotment basis.

Temporary forage loss, under current management, expressed in AUMs, by action alternative, is shown in Table 3–129 below. AUMS lost are calculated by multiplying disturbed acres x percent of allotment acres suitable for livestock grazing, and dividing by the allotment stocking rate on suitable lands. Forage losses are not calculated for vacant or non-stocked allotments as there is no livestock forage loss. On BLM grazing allotments suitable grazing lands are estimated at 80 percent of allotments acres. AUMS are calculated to the nearest whole number.

**Table 3–129 Temporary Forage Losses on Stocked Grazing Allotments**

| | Loss of Forage by Alternative (AUM) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 1A | | 1B | | 2 | | 3 | | 4 | |
| Active Grazing Allotment | Short-Term | Long-Term | Short-Term | Long-Term | Short-Term | Long-Term | Short-Term | Long-Term | Short-Term | Long-Term | Short-Term | Long-Term |
| Florida River - BLM | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 3 | 0 | 0 | 0 | 0 |
| West Rabbit Mtn. - BLM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| North Canby - BLM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mahan - BLM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| South Canby - BLM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Little Bear - FS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bonnell Canyon - FS | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 0 | 0 | 0 | 0 |
| Sauls Creek - FS | 6 | 4 | 5 | 4 | 5 | 4 | 10 | 7 | 5 | 3 | 4 | 3 |
| HD - FS | 0 | 0 | 4 | 3 | 4 | 3 | 12 | 8 | 3 | 2 | 5 | 3 |
| Mosca - FS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Freeman Creek - FS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Turkey - FS | 3 | 2 | 3 | 2 | 1 | 1 | 4 | 2 | 2 | 1 | 1 | 0 |
| Total | 9 | 6 | 12 | 9 | 10 | 8 | 33 | 22 | 10 | 6 | 10 | 6 |

In addition to the ownership-related considerations discussed previously, the duration of the land disturbances were considered for the analysis of land use impacts from the proposed project. Table 3–130 shows the estimated acres of surface disturbance within each land use category by surface ownership for the proposed project. Construction of CBM facilities will involve disturbances for well pads, compressor stations, access roads, pipelines, and disposal wells. After construction, pipelines and portions of the well pads, or other facilities not needed for production, will be reclaimed. The remaining acres of disturbance would be displaced for the productive life of the project until decommissioning and final reclamation occurs. The dedicated facilities would represent conversion of the pre-project resources to CBM-related uses for the life of the project.

## Table 3–130 Summary of Impacts by Land Use Category, Surface Ownership, and Alternative

| | Areal Extent of Disturbance by Surface Ownership | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BLM | | NFS | | State | | Private | | Total[1] | |
| Land Use Category by Alternative | Construction (acres) | Operation (acres) | Construction (acres) | Operation (acres) | Construction (acres) | Operation (acres) | Construction (acres) | Operation (acres) | Construction (acres) | Operation (acres) |
| Alternative 1 | | | | | | | | | | |
| Agriculture/Rangeland | 0.0 | 0.0 | 7.7 | 5.1 | 5.8 | 5.0 | 110.0 | 75.2 | 123.5 | 85.2 |
| Undeveloped | 25.2 | 17.0 | 712.1 | 464.1 | 15.7 | 11.5 | 38.4 | 25.5 | 798.5 | 524.3 |
| Residential | 3.0 | 2.0 | 0.1 | 0.1 | 0.0 | 0.0 | 87.5 | 59.1 | 90.7 | 61.2 |
| Urban and Roads | 3.0 | 2.0 | 2.4 | 1.6 | 0.0 | 0.0 | 5.2 | 3.5 | 10.6 | 7.1 |
| Total | 31.2 | 21.0 | 722.3 | 470.8 | 21.5 | 16.5 | 241.2 | 163.2 | 1,023.1 | 677.6 |
| Alternative 1A | | | | | | | | | | |
| Agriculture/Rangeland | 0.0 | 0.0 | 7.6 | 5.0 | 5.8 | 5.0 | 110.0 | 75.2 | 123.5 | 85.2 |
| Undeveloped | 25.2 | 17.0 | 565.8 | 408.6 | 15.7 | 11.5 | 36.4 | 24.3 | 650.1 | 467.7 |
| Residential | 3.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 89.5 | 61.1 | 92.5 | 63.1 |
| Urban and Roads | 3.0 | 2.0 | 2.0 | 2.0 | 0.0 | 0.0 | 5.2 | 3.5 | 10.2 | 7.5 |
| Total | 31.2 | 21.0 | 575.4 | 415.6 | 21.5 | 16.5 | 241.2 | 164.1 | 875.8 | 623.2 |
| Alternative 1B | | | | | | | | | | |
| Agriculture/Rangeland | 0.0 | 0.0 | 7.6 | 5.0 | 5.8 | 5.0 | 110.0 | 75.2 | 123.5 | 85.2 |
| Undeveloped | 25.2 | 17.0 | 347.0 | 276.8 | 7.2 | 6.0 | 30.7 | 21.0 | 414.1 | 324.0 |
| Residential | 3.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 87.5 | 59.1 | 90.5 | 61.1 |
| Urban and Roads | 3.0 | 2.0 | 2.0 | 2.0 | 0.0 | 0.0 | 5.2 | 3.5 | 10.2 | 7.5 |
| Total | 31.2 | 21.0 | 356.6 | 283.8 | 13.0 | 11.0 | 233.5 | 158.8 | 638.2 | 477.7 |
| Alternative 2 | | | | | | | | | | |
| Agriculture /Rangeland | 3.0 | 2.0 | 7.7 | 5.1 | 8.4 | 6.8 | 201.4 | 136.8 | 220.5 | 150.6 |
| Undeveloped | 49.2 | 33.0 | 1,135.4 | 744.3 | 34.0 | 23.8 | 132.4 | 88.8 | 1,357.9 | 896.2 |
| Residential | 6.0 | 4.0 | 0.1 | 0.1 | 0.0 | 0.0 | 158.0 | 106.6 | 164.1 | 110.7 |
| Urban and Roads | 3.0 | 2.0 | 2.4 | 1.6 | 0.0 | 0.0 | 5.2 | 3.5 | 10.6 | 7.1 |
| Total | 61.2 | 41.0 | 1,145.5 | 751.0 | 42.4 | 30.6 | 497.0 | 335.7 | 1,753.0 | 1,164.4 |
| Alternative 3 | | | | | | | | | | |
| Agriculture /Rangeland | 0.0 | 0.0 | 7.7 | 5.1 | 5.8 | 5.0 | 107.4 | 73.4 | 120.9 | 83.5 |
| Undeveloped | 25.2 | 17.0 | 392.0 | 257.1 | 18.4 | 13.2 | 36.3 | 24.6 | 478.9 | 318.0 |
| Residential | 3.0 | 2.0 | 0.1 | 0.1 | 0.0 | 0.0 | 90.1 | 60.8 | 93.3 | 62.9 |
| Urban and Roads | 3.0 | 2.0 | 2.4 | 1.6 | 0.0 | 0.0 | 5.2 | 3.5 | 10.6 | 7.1 |
| Total | 31.2 | 21.0 | 402.2 | 263.8 | 24.2 | 18.2 | 239.0 | 162.3 | 703.5 | 471.4 |
| Alternative 4 | | | | | | | | | | |
| Agriculture /Rangeland | 0.0 | 0.0 | 8.2 | 5.4 | 2.8 | 2.0 | 104.7 | 71.6 | 115.7 | 79.0 |
| Undeveloped | 25.2 | 17.0 | 410.6 | 267.6 | 12.8 | 9.8 | 42.3 | 28.5 | 497.9 | 329.1 |
| Residential | 3.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 92.3 | 62.2 | 95.3 | 64.2 |
| Urban and Roads | 3.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.2 | 3.5 | 8.2 | 5.5 |
| Total | 31.2 | 21.0 | 418.8 | 272.9 | 15.6 | 11.8 | 244.5 | 165.8 | 717.2 | 477.6 |
| Alternative 5 | | | | | | | | | | |
| Agriculture /Rangeland | 0.0 | 0.0 | 0.0 | 0.0 | 5.8 | 5.0 | 115.2 | 78.7 | 121.0 | 83.7 |
| Undeveloped | 0.0 | 0.0 | 91.3 | 58.9 | 13.6 | 10.2 | 26.1 | 17.6 | 134.0 | 89.8 |
| Residential | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 101.8 | 68.6 | 101.8 | 68.6 |
| Urban and Roads | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 7.8 | 5.3 | 7.8 | 5.3 |
| Total | 0.0 | 0.0 | 91.3 | 58.9 | 19.4 | 15.2 | 251.0 | 170.2 | 364.6 | 247.3 |

Note:

[1] Totals may not match precisely with values obtained by adding unit numbers because of rounding conventions, because some well locations are undetermined, and because some facilities are outside of the Project Area.

### 3.11.3.1.1 Alternative 1 — Proposed Action

Alternative 1 would impact a total of 1,023 acres during construction and installation of the proposed CBM facilities. The locations of the proposed CBM facilities within each land use category are shown on Figure 3–41. Most of the CBM facilities would be located on rangeland and undeveloped land. Within the Project Area, 124 acres of agricultural or rangeland and 799 acres of undeveloped land would be affected during construction (Table 3–130). Construction would also impact 91 acres of residential land and acreage in other areas within the Project Area.

Alternative 1 would primarily affect rangeland and undeveloped land (Table 3–127). Of the undeveloped land that would be affected, most consists of federal lands in the SJNF that are also used for livestock grazing and dispersed recreation.

Some agricultural and undeveloped lands would be removed from rangeland use for the life of the project because of displacement by dedicated CBM facilities. Under Alternative 1, less than one percent of the total rangeland in the Project Area would be affected.

Approximately 17 wells would be constructed in farmland, removing the farmland acreage from production. Under Alternative 1, less than 1 percent of the total farmland in the Project Area would be affected. Impacts to prime farmlands are discussed in the Soils section of this chapter.

CBM construction in agricultural lands would damage or displace existing vegetation, such as crops or forage for livestock. Clearing the land would also increase the potential to introduce and spread weeds.

Dedicated CBM facilities located on agricultural lands would displace existing crops or rangeland during the operational and maintenance phases of the project. At least 30 years would lapse before the pre-existing agricultural land uses would be re-established after the project-related facilities are decommissioned and reclaimed.

Land use conflicts may occur at locations where CBM wells would be located on split-estate agricultural lands with private surface ownership and severed minerals. Six proposed CBM facilities would be located on split-estate agricultural lands (Table 3–128). All of the proposed well locations on private split-estate agricultural lands are within La Plata County.

The federal permitting process is designed to reduce the potential impacts to land uses for CBM development on lands with federal minerals. The BLM and FS would require surface use agreements, and the well locations would be negotiated with the landowners for development on properties with private surface ownership and federal minerals. Compensation for surface damages, ROW, and access agreements would be negotiated with surface owners. Landowner agreements would be negotiated with the CBM developer on severed private mineral estate much the same way as is done for federal mineral estate. In this case, the county would be involved in on-site negotiations.

Rangeland impacts would include reduced carrying capacity and overall disruption to and restriction of current livestock management and range. During the construction phase, clearing of vegetation and earth moving operations would damage or remove forage for livestock grazing. Surface disturbance may also introduce noxious weeds. The carrying capacity of some rangeland would be reduced. Both overgrazed and underused areas may result from changes to grazing patterns.

The removal of native vegetation associated with the construction of the project facilities enhances opportunities for invasion and establishment of noxious weeds. The extent of these invasions is difficult to predict; however, noxious weed infestations may reduce the percentage of suitable forage species for livestock in the grazing allotments, resulting in AUM losses. The San Juan/San Miguel Planning Area RMP and amended RMP (BLM 1985, 1991), and the Decision Record for the Standards for Public Land Health and Guidelines for Livestock Grazing Management (BLM 1997) apply to development on BLM lands. Noxious weeds on NFS lands in the Project Area are managed under the San Juan/Rio Grande National Forest Weed Management Plan. CBM development would be subject to mitigation measures for weed control, minimizing the impacts of noxious weeds on forage and rangeland in the Project Area. Noxious weeds are discussed in the Vegetation section of this chapter.

Timbered ridges act as barrier to cattle movement in the grazing rotations. When access roads are constructed through these barriers, cattle use them as corridors into areas that are being deferred from grazing. It may be necessary to construct fences and install cattle guards in some of these access roads if cattle movement is persistent. In addition, existing range improvements, such as ponds, fences, and spring developments, need to be protected.

An increase in the number of roads constructed in grazing areas and additional project-related traffic would increase the potential for disturbance or harassment of animals or collisions with livestock. New access roads or additional fencing that bisects fields may also fragment rangeland and limit movement of livestock.

The county-designated residential lands are classified into three categories: rural residential, existing subdivisions, and proposed subdivisions. Some proposed wells would be within or near existing or proposed subdivisions or rural residential lots in La Plata County (Figure 3–41). Land use conflicts have and will continue to occur where CBM facilities are located near private residential lands, such as subdivisions and rural residential properties. As shown in Table 3–128, four proposed CBM wells would be located on split-estate residential land under Alternative 1.

Conflicts will continue where CBM development encroaches on subdivisions and individual residences. The land use codes designed to reduce impacts from CBM development cannot fully mitigate these land use conflicts. These conflicts are particularly acute where surface landowners derive no monetary benefit from the well's production and incur possible property value loss caused by CBM development.

Intrusive effects to adjoining or nearby residential properties would occur from the sights and sounds of CBM-related activities. These effects may include increased fugitive dust, noise, and traffic delays on the roads; physical intrusion of the crew and equipment; and visual or aesthetic effects that could devalue residential properties. Some of these effects would occur during the construction and phase of CBM development and would be limited in duration because a well would be drilled within several weeks. Potential effects to residential property values are analyzed in the Social and Economic Values section of this chapter.

#### 3.11.3.1.2 Alternative 1A

Alternative 1A would impact a total of 876 acres during construction and installation of the proposed CBM facilities. Potential agricultural, rangeland, undeveloped land, and residential land use impacts would be similar to Alternative 1. Impacts within the west side of the Project Area would be identical to Alternative 1, particularly the residential impacts. There would be fewer surface locations on the SJNF and therefore less rangeland impact.

#### 3.11.3.1.3 Alternative 1B

Alternative 1B would impact a total of 638 acres during construction and installation of the proposed CBM facilities. Land use impacts would be similar to Alternatives 1 and 1A but somewhat less impacting to rangeland on the SJNF due to fewer well pads and access roads.

#### 3.11.3.1.4 Alternative 2

Alternative 2 would directly impact 1,753 acres. The areal extent of this disturbance would represent 1.4 percent of the Project Area. This disturbance would involve 221 acres of agricultural or rangeland, 1,358 acres of undeveloped land, 164 acres of residential land, and acreage in other areas within the Project Area.

The areal extent of land uses displaced by CBM facilities would be greater than that of any other alternative, affecting twice the residential land and twice the undeveloped land than Alternative 1. The additional development would be concentrated within the 1½ mile near outcrop zone for the Fruitland formation and on grazing lands on the SJNF. Land use conflicts would increase when compared with Alternative 1.

#### 3.11.3.1.5 Alternative 3

Alternative 3 would impact 704 acres of mixed land uses (Table 3–130). The areal extent of this disturbance represents less than 1 percent of the Project Area. This disturbance would involve 121 acres of agricultural or rangeland, 479 acres of undeveloped land, 93 acres of residential land, and acreage in other areas in the Project Area. Land use impacts on the west side of the Project Area would be the same as Alternative 1. East side Project Area impacts to rangelands would be slightly less than Alternative 1.

#### 3.11.3.1.6 Alternative 4

Under Alternative 4, facility construction would impact 717 acres of current land uses (Table 3–130). The areal extent of this disturbance would represent less than 1 percent of the Project Area. This disturbance would involve 116 acres of agricultural or rangeland, 498 acres of undeveloped land, 95 acres of residential land, and acreage in other areas in the Project Area.

Alternative 4 would displace a smaller amount of current land uses when compared with Alternatives 1 and 2. However, the effects to rangeland, undeveloped land, and residential land uses would be similar to Alternative 1.

#### 3.11.3.1.7 Alternative 5 — No Action

Under Alternative 5, facility construction would impact 365 acres of current land uses (Table 3–130). The areal extent of this disturbance would represent less than 1 percent of the Project Area. This disturbance would include 121 acres of agricultural or rangeland, 134 acres of undeveloped land, 102 acres of residential land, and acreage in other areas in the Project Area. Private and state land impacts on would be as described for Alternative 1. No land use impacts would occur to federal lands at this time under Alternative 5.

### 3.11.3.2 Unroaded Lands within the Project Area

CBM development of existing leases would affect the unroaded lands in the HD Mountains to varying degrees. The extent of impact varies by alternative. Table 3–131 summarizes the number of well pads and miles of road constructed within the unroaded area by alternative. Table 3–131 also presents the acres of unroaded land that would remain following implementation of each alternative.

**Table 3–131 Impact to Unroaded Lands by Alternative**

| | Alternatives | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Well pads | 57 | 36 | 15 | 103 | 0 | 24 | 0 |
| Roads (miles) | 38 | 29 | 16 | 61 | 0 | 25 | 0 |
| Unroaded Area Impacted by New Roads (acres) | 12,385 | 11,705 | 6,297 | 22,799 | 1,774 | 13,616 | 0 |
| Unroaded Area Remaining (acres) | 15,411 | 16,091 | 21,499 | 4,997 | 26,022 | 14,180 | 27,796 |

#### 3.11.3.2.1 Alternative 1 — Proposed Action

Fifty-seven well pads and 38 miles of road would be constructed in the unroaded portion of the HD Mountains. Approximately 44 percent of the existing unroaded area would be impacted, leaving a residual area of 15,411 acres unroaded. The remaining area would form two smaller, non-contiguous blocks of 12,028 and 3,383 acres respectively within the core of the HD Mountains (Figure 3–42). The spine of the HD Mountains Inventoried Roadless Area would be developed from the terminus of FSR 756 in a north-south pattern that approximately follows the old stock driveway.

The leaseholder proposes surface development on portions of lease COC-64935 (1,372 acres) issued within the HD Mountains Roadless Area in May 2001 with NSO stipulations. Nine wells are proposed in the NSO area. An APD has been filed for one well and an on-site review of the staked well location conducted. The APD will be acted on in the ROD for this project. Procedurally, NSO waiver determinations would be made at company request when APDs are submitted to develop the remaining proposed wells within the lease area. Surface occupancy on portions of the lease would be consistent with the lease terms, which allow waiver of the NSO stipulation if surface conditions permit surface occupancy without undue environmental impact. When lease COC-64935 was issued, the FS Roadless Conservation Rule was in effect. The rule's effect would have been to make the leases NSO stipulation non-waivable.

The leaseholder does not propose development of lease COC–64936 (998 acres) at this time. Lease COC-64936, within the HD Mountains Inventoried Roadless Area, was also issued in May 2001 with NSO stipulations.

#### 3.11.3.2.2 Alternative 1A

Alternative 1A would result in similar impact to the unroaded portion of the Project Area to those described for Alternative 1. A total of 11,705 acres would be impacted and 16,091 acres would remain unroaded after full implementation of Alternative 1A (Figure 3–43) Revise this acreage total based on the map correction.

There would be one well pad within lease COC-64935 that would require NSO stipulation waiver. Other locations within the lease area would be directionally drilled from the lease perimeter into the lease's interior.

#### 3.11.3.2.3 Alternative 1B

Alternative 1B would impact 6,297 acres of unroaded area, fourth among the alternatives in terms of overall impact. Two areas totaling 21,499 respectively would remain unroaded following the alternative's implementation. By horizontal drilling to a number of down-hole locations, some proposed access roads would be eliminated. Thus, the residual unroaded area would be slightly larger than Alternative 1 (Figure 3–44).

There would be one multiple well pad within lease COC-64935 that would require waiver of the NSO stipulation. Other locations within the lease area would be directionally drilled from the lease perimeter into the lease's interior.

#### 3.11.3.2.4 Alternative 2

Alternative 2 would result in construction of 103 well pads and 61 miles of road in the unroaded portion of the HD Mountains. Alternative 2 would impact 22,799 acres of unroaded area, the largest impact among the alternatives. Three residual pockets of unroaded area would remain, totaling 4,997 acres (Figure 3–45).

Nine wells are proposed in the NSO lease area, COC-64935. The one surface location where an APD has been submitted would be acted on in the Record of Decision for this project. NSO waiver requests for the other eight locations would be examined when APDs are submitted.

Six wells would be developed with in lease area COC-64936 in Alternative 2.

#### *3.11.3.2.5 Alternative 3*

Alternative 3 results in the second lowest impact among the alternatives, impacting 1,774 acres of unroaded area. A total of 26,022 acres of contiguous area would remain unroaded following the alternative's implementation (Figure 3–46).

No wells would be drilled within lease area COC-64935 or directionally drilled into the NSO lease.

No wells would be developed within lease area COC-64936.

#### *3.11.3.2.6 Alternative 4*

Alternative 4 would impact 13,616 of unroaded area, second highest among the alternatives. The contiguous unroaded area would be split into two residual areas totaling 11,776 and 3,383 acres, respectively (Figure 3–47).

One well would be drilled within lease COC-64935. This well would require a partial waiver of the lease's NSO stipulation.

Two wells would be developed with in lease area COC-64936 in Alternative 2.

#### *3.11.3.2.7 Alternative 5 — No Action*

No wells or roads would be located in the unroaded area at this time (Figure 3–48). Therefore, 27,796 acres would remain unroaded.

### 3.11.3.3 Archuleta Mesas — Potential Research Natural Area

The leaseholder proposes to develop eight wells and one compressor in the Archuleta Mesas area, lease COC-64932. Alternative 1 would develop the leases according to the companies' proposed action. Alternative 1A modifies the proposed action, drilling 11 wells from six well pads. Alternative 1B involves drilling multiple well bores from two well pads. Alternatives 2 and 3 involve the same development scenario as Alternative 1. Alternative 5 would deny the companies' proposal; thus, no surface development of the lease would occur at this time.

The way in which the Archuleta Mesas lease area is developed hinges on forthcoming land management decisions in the FS LRMP revision process. If Archuleta Mesas were recommended for inclusion in the system of research natural areas, the NSO stipulation that now applies to the lease would remain in effect. If not recommended, the FS and BLM would evaluate the companies' request for NSO waiver on a case-by-case basis as notices of staking or applications for permit to drill are received.

## 3.11.4 Cumulative Effects

Cumulative land use effects are defined as the sum of the past, present, and reasonably foreseeable actions that may affect land use patterns within La Plata and Archuleta Counties. The cumulative effects analysis includes the sum of the long-term oil and gas development impact within the portion of the NSJB in La Plata and Archuleta Counties. The areal extent of land displaced by existing and proposed oil and gas development within the Project Area for each land use category is shown in Table 3–132.

Under Alternative 1, the cumulative effects of CBM development within La Plata and Archuleta Counties, including the SUIT Reservation, would include total displacement of existing land uses from 3,701 acres for CBM facilities for the life of the project. Land use conflicts between CBM development and residential growth would be amplified over the cumulative effects area. However, large-scale changes to growth patterns are not likely to result from the proposed CBM development. In La Plata County, an increase in residential construction and urban growth is expected to occur along with an increase in the number of gas wells (La Plata County 2002b). Archuleta County would experience a similar response to CBM development.

Under the action alternatives there should be little adverse impact to the forage resource in the future. Re-seeded disturbed areas could actually produce more forage than before disturbance. Livestock distribution could actually improve due to better access using reclaimed roads. Should this occur, there could be less overall grazing pressure on key areas such as riparian bottoms. Therefore, forage conditions on key areas should continue to meet or exceed standards contained in land management plans.

**Table 3–132 Cumulative Displacement of Land for Oil and Gas Facilities, by Land Use Category and Alternative**

| | | | Cumulative Land Displacement for Oil and Gas Facilities by Alternative[2] (acres) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Land Use Category | Existing Oil and Gas Facilities in Project Area (acres) | SUIT FEIS Preferred Alternative[1] (acres) | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Agriculture/Rangeland[3] | 267 | 1,082 | 1,434 | 1,434 | 1,434 | 1,500 | 1,433 | 1,428 | 1,433 |
| Undeveloped | 204 | 1,310 | 2,038 | 1,982 | 1,838 | 2,410 | 1,832 | 1,843 | 1,604 |
| Residential | 80 | 68 | 209 | 211 | 209 | 258 | 211 | 212 | 217 |
| Urban and Roads | 2 | 10 | 19 | 20 | 20 | 19 | 19 | 18 | 17 |
| Total[4] | 553 | 2,470 | 3,701 | 3,647 | 3,501 | 4,187 | 3,495 | 3,501 | 3,271 |

Notes:

1. Most of the land displacement associated with the SUIT FEIS Preferred Alternative is within La Plata County.
2. Cumulative is the sum of long-term land displacement for existing oil and gas facilities, SUIT FEIS Preferred Alternative, and the proposed CBM facilities for each alternative.
3. The agriculture/rangeland category includes farmland.
4. Totals may not match precisely with values obtained by adding unit numbers because of rounding conventions.

With or without additional CBM development, the current trends in development in La Plata County suggest that future urban growth would be primarily concentrated in the areas southeast of the City of Durango near the intersection of U.S. Highway 550 and U.S. Highway 160 and around the Town of Bayfield. CBM development should not alter this growth pattern. Currently, no major industrial projects, such as power plants or manufacturing facilities, are planned in La Plata County (BLM et al. 2002). The current trends in development for Archuleta County indicate no future urban areas within the Project Area.

## 3.11.5 Mitigation and Monitoring

BLM is responsible for issuing and managing leases that involve federal minerals and for specifying mitigation measures to protect surface resources as part of the APD approval process. The FS has similar responsibilities for development on NFS lands as part of the authorization of surface use plans. Unless otherwise stated, the following measures will be funded by the Companies.

The companies would be required to develop reclamation and revegetation plans for all areas impacted by CBM-related facilities. Through the APD process, the specific locations of the new CBM facilities would be selected to avoid or minimize conflicts with nearby existing land uses. For split-estate lands, CBM facilities would be sited with input from the landowner and surface use agreements would be developed with the landowner, including negotiated compensation for loss or compromise of land use.

The mitigation measures currently required, such as noise ordinances, setbacks, and participation in visual mitigation, would reduce, but not eliminate, potential impacts to land use. No additional mitigation measures were identified.

### 3.11.5.1 Rangeland Management Mitigation Measures

Construct fences and install cattle guards as necessary to manage livestock movement if natural barriers are impacted by project facilities.

Protect existing range improvements, such as ponds, fences, and spring developments. The companies would be responsible for repairing and/or replacing any improvements damaged by project implementation.

Protect or avoid all permanent monitoring stations. These include, but are not limited to locations of Parker 3-step transects, rooted nested frequency transects, grazing exclosures, and browse transects.

## 3.11.6 Conformance with Existing Plans and Policies

The land use plans and policies that apply to CBM development vary depending on surface and mineral ownership of the properties where CBM facilities would be installed.

CBM-related surface disturbances that affect federal land are under the jurisdiction of either BLM or FS. BLM and FS management plans for federal lands in the Project Area support mineral development, including oil and gas. Oil and gas development on federal lands must conform to the applicable lease stipulations, best management practices, and additional mitigation measures, where required. The guidance documents and policies for CBM development on federal lands in the Project Area include:

- The San Juan and San Miguel RMP and EIS and amended RMP (BLM 1984a, 1984b, 1991),
- The Colorado Oil and Gas Leasing and Development FEIS (BLM 1991),
- The San Juan National Forest LRMP (FS 1983) and the amended LRMP (FS 1992),
- The 1997 Public Land Health Standards for BLM lands in Colorado.
- The Interim Criteria for Fruitland CBM Development set forth in NTL No. CO-SJFO-2001-01 (BLM 2000c),
- The current spacing orders, which allow two wells per 320 acres in La Plata County (COGCC 2000a) and one well per 320 acres in Archuleta County (COGCC 1990).

A site-specific NEPA analysis is completed when applications for an APD, BLM ROW grant, or FS SUP are filed with the BLM and FS. At that point, a specific well or group of wells is assessed in detail, and mitigation measures are attached as conditions of approval (COAs) to the individual permit. The COA must reflect both the lease rights granted and the management requirements of the 1984 RMP, 1991 amended RMP and Colorado EIS, and the 1983 LRMP and 1992 amended LRMP.

La Plata County has developed several regional land use plans within the Project Area. These plans include maps that define the future goals for land use for each planning area. The plans are advisory documents for the county and are not regulations. Most of the proposed CBM wells in La Plata County would be located where the future land use designation is agricultural. CBM facilities are generally considered compatible with agricultural land use (La Plata County 2002b, BLM et al. 2002).

No CBM facilities are proposed on private properties in Archuleta County. All of proposed CBM facilities to be located in Archuleta County would be on federal undeveloped land in the San Juan National Forest. The county land use regulations would not apply for proposed CBM facilities located on federal properties because the county has no jurisdiction over development on federal lands.

### 3.11.6.1 Alternative 1 — Proposed Action

With respect to general land uses, which are a broad category of multiple use zones used on federal lands, Alternative 1 would conform to the current management plans for federal lands in the Project Area. With respect to the rules, orders, and requirements that pertain to energy mineral development, Alternative 1 would conform to current spacing orders in La Plata County on private, state, and federal jurisdictions. In May 2000, the BLM issued a decision and order that allowed for infill development of CBM wells on federal lands in the NSJB. All of the windows and locations that make up this alternative are consistent with the Interim Criteria for Fruitland and CBM Development set forth in NTL No. CO-SJFO-2001-01 (BLM 2000c).

Alternative 1 does not comply with current COGCC spacing rules for wells in the Fruitland Formation in Archuleta County. The current rule (COGCC 112-85) permits one well per 320-acre spacing unit, whereas Alternative 1 presents industry's proposal to develop these leases at two wells per 320 acres. Full implementation of Alternative 1 in Archuleta County would require a change in the current well spacing rule for the Fruitland Formation to two wells per 320-acre unit. Establishment of well field spacing rules falls within the authority of the COGCC on private and state land and within the authority of the BLM on federal mineral estate.

If not permanently enjoined by the Wyoming Federal District Court, the Roadless Area Conservation Rule (FS 2001a, b) would bar surface development of two leases, COC-64935 and COC-64936. Cases regarding the legality of the Roadless Conservation Rule have been heard in Idaho and Wyoming with split rulings, and a case is currently being heard in North Dakota. There is the possibility of a three-way split on the legality of the rule and the possibility of competing injunctions. The legal cloud cast over the Roadless Rule may be resolved by the time a Record of Decision is issued for this project.

Alternative 1 is consistent with the Interim Criteria for Fruitland CBM Development set forth in NTL No. CO-SJFO-2001-01 (BLM 2000c). These criteria require that no wells would be developed on federal jurisdiction within 1.5 miles of the outcrop to the Fruitland Formation pending completion of this EIS. This EIS then becomes the basis for evaluation of further development within the near-outcrop zone, and the extent of permitted development will be outlined in the ROD for this project. It is not inconsistent with the Interim Criteria for industry to propose development within this zone.

CBM development on private or state leases would conform to both COGCC requirements and the existing local land use policies.

### 3.11.6.2 Alternative 1A

The same consistency results that apply to Alternative 1, apply to Alternative 1A.

### 3.11.6.3 Alternative 1B

The same consistency results that apply to Alternative 1, apply to Alternative 1A.

### 3.11.6.4 Alternative 2

Alternative 2 would conform to the current management plans for federal lands in the Project Area. There is no inconsistency with the multiple-use goals established for the BLM and NFS lands defined in the federal land and resource management plans.

Alternative 2 attempts to analyze the consequences of maximum development of the Fruitland Formation. In doing so, Alternative 2 does not comply with current COGCC spacing rules for Fruitland Formation wells in Archuleta County. Full implementation of Alternative 2 in Archuleta County would require a change in the current well spacing rule for the Fruitland Formation to two wells per 320-acre unit.

Alternative 2 is consistent with the Interim Criteria for Fruitland CBM Development set forth in NTL No. CO-SJFO-2001-01 (BLM 2000c). It is also consistent with the COGCC criteria for CBM development in the near-outcrop zone (COGCC 2000a). The COGCC requires specific procedures for hearing and review for approval of wells within 1.5 miles of the outcrop zone on private and state lands.

CBM development on private or state leases would conform to both COGCC requirements and the existing local land use policies.

### 3.11.6.5 Alternative 3

In general, Alternative 3 would conform to the current management plans for federal lands in the Project Area. There is no inconsistency with the multiple-use goals established for BLM and NFS lands as defined in the federal land and resource management plans. Land use goals for federal lands are expressed as management area prescriptions. Management area prescriptions are similar to zoning restrictions and describe the types of activities that are emphasized and permitted within each zone.

From the standpoint of energy development in the HD Mountains, this alternative is not consistent with the lease rights granted in the Inventoried Roadless Area. Alternative 3 does not permit development of existing leases that would otherwise qualify for development after review of environmental consequences and compliance with law and regulation.

Alternative 3 does not comply with current COGCC spacing rules for wells in the Fruitland Formation in Archuleta County. Full implementation of Alternative 3 in Archuleta County would require a change in the current Fruitland well spacing rule to two wells per 320-acre unit.

CBM development on private or state leases would conform to both COGCC requirements and the existing local land use policies.

### 3.11.6.6 Alternative 4

Alternative 4 conforms to the current management plans for federal lands in the Project Area. There is no inconsistency with the multiple use goals established for BLM and NFS lands as defined in the federal resource management plans.

Alternative 4 complies with current COGCC spacing rules for wells in the Fruitland Formation in Archuleta County.

CBM development on private or state leases would conform to both COGCC requirements and the existing local land use policies.

### 3.11.6.7 Alternative 5 — No Action

Alternative 5 does not conform to the current management plans for federal lands in the Project Area. There is inconsistency with the multiple use goals as defined in the federal land and resource management plans for management of federal lands within the Project Area.

Alternative 5 is not consistent with the rights conveyed by existing leases on federal lands. Federal land use goals include mineral development on federal lands with existing leases, subject to compliance with the terms of the lease and with applicable laws, regulations, and policy.

CBM development on private or state leases would conform to both COGCC requirements and the existing local land use policies.

## 3.11.7 Unavoidable Adverse Effects

Unavoidable adverse effects would include displacement of existing agricultural, rangeland, and undeveloped federal lands for CBM well facilities for the life of the project. In addition, CBM-related activities may result in intrusive effects to nearby residential properties. These effects may include increased dust, noise, visual, or aesthetic effects, and traffic delays on the roads. These effects would occur primarily during the construction phase of CBM development.

## 3.11.8 Irreversible and Irretrievable Effects

After reclamation is complete, the pre-existing land uses would be re-established. However, some access roads constructed for energy mineral development may be retained as part of the permanent FS road system after project completion. Retaining these roads would represent a long-term conversion of the pre-project resources to road use. This action is irretrievable, but is not irreversible.

# 3.12 Recreation

## 3.12.1 Issues

*Issue 14 Effect of additional CBM development on recreational opportunities.*

Facets of this issue include the following:

- How will recreational opportunities and amenities be affected, particularly near towns and residential areas?
- Will new roads provide additional access for vehicles and promote an increase in human activity, particularly on NFS land and areas that are currently roadless?
- How will increased human activity affect wildlife-related recreation (viewing wildlife, hunting wildlife, and fishing)?

## 3.12.2 Affected Environment

### 3.12.2.1 Recreation Use and Management

Land in La Plata and Archuleta Counties offers diverse recreational opportunities, including but not limited to camping, backpacking, hiking, mountain biking, fishing, sightseeing, landscape photography, hunting, picnicking, whitewater rafting, horseback riding, ATV riding, other motorized-vehicle uses, and winter sports. Trail-related recreation is in high demand in La Plata County and generates substantial tourism. The Project Area includes existing or planned, developed trail systems, as well as recreation on unmaintained, casual dispersed trails on federal land (Figure 3–49).

#### *3.12.2.1.1 Developed Recreation*

Developed recreation in the Project Area is limited to privately owned or city-managed facilities in or near Durango and Bayfield. No developed facilities are on NFS or BLM land in the Project Area, nor are there any county-owned or -operated facilities in the Project Area.

The Durango East KOA campground along U.S. Highway 160 in the western side of the Project Area operates between April 15 and October 15. The Cottonwood Camper Park is located on Highway 160 between Bayfield and Durango. The Riverside Recreational Vehicle (RV) Park is on Highway 160 northeast of Bayfield. There are no other developed recreation sites are in the Project Area, but there are numerous opportunities for developed recreation in La Plata and Archuleta Counties outside the Project Area. County roads that cross through the Project Area provide access to recreation sites at Vallecito Reservoir and Lemon Reservoir, both 5 miles to the north, and to Navajo Reservoir to the southeast.

The proposed Cedar Hills Golf Course and residential subdivision is on 703 acres between County Road 223 and Highway 160, about 12 miles east of Durango. This subdivision would be on land currently part of the Wildorado Ranch, in the heart of the Project Area. It is in an area of existing oil and gas exploration and production where additional development of CBM is planned. In addition, a regional park may be developed in the Grandview area.

### 3.1.2.1.2 Dispersed Recreation

A broad spectrum of dispersed recreation occurs year-round in La Plata and Archuleta Counties. Summer activities include hiking, mountain biking, hunting, fishing, camping, sightseeing, ATV riding, landscape photography, and wildlife viewing. Dispersed winter activities include cross-country skiing, snowmobiling, and snowshoeing. Numerous 4-wheel-drive roads and unmaintained trails traverse the Project Area and offer opportunities for dispersed activities. Outfitters and guides provide for some dispersed uses (hunting) as well as trail uses (mountain biking and horseback riding).

Bicycle commuters, recreational bicyclists, and competitive bicyclists training for races use Highways 160 and 500 and the La Plata County Road system. The La Plata County Comprehensive Traffic Study has defined the network of bicycle routes within the Project Area, described in Table 3–133. County Roads 234 and 501 and U.S. 160 access several existing CBM wells.

**Table 3–133 Bicycle Routes in the Northern San Juan Basin Project Area**

| Road Name | From | To | Bicycle Route Name |
|---|---|---|---|
| CR 234 | Intersection of CR 240 | Intersection of U.S. 160 | Durango Loop |
| CR 501 | Intersection of CR 240 | Intersection of U.S. 160 | Helen's Store/Bayfield/ Ignacio Loop |
| U.S. 160 | Durango City Limit | La Plata County East County Line | U.S. 160 East from Durango to county line |
| U.S. 550 | Intersection of CR 220 | Durango City Limit | Durango Loop/Helen's Store/Bayfield/Ignacio Loop |

Source: La Plata County Planning Department 1999

Motorized uses, including 4-wheel-drive vehicles, are available throughout most NFS land in the Project Area. OHVs are restricted to June 1 to November 2 on NFS land, eliminating snowmobile use. BLM land is open to OHVs, but these uses are limited on BLM parcels in the Project Area because they are small and isolated and are not suitable for OHVs, with the exception of the Grandview area.

### 3.12.2.1.3 Trails

The Grandview Ridge Trail System is southeast of Durango on BLM and private land in the western portion of the Project Area. The intersecting trails are heavily used by mountain bikers, as well as by hikers, horseback riders, and hunters. The trails are not accessible to motorized vehicles.

These trails are the southern portion of a more extensive system that is easily accessible from Durango and is a popular recreation area with local residents and tourists. Trails on Grandview Ridge in the Project Area include Carbon Junction, Crites Connect, Telegraph, Sidewinder, Skull Rock Loop, Grandview Rim Trail, Sale Barn, Grandview Ridge Trail, Old Car Loop, and Cowboy Trail. These are primarily on BLM land. The outcrop of the Fruitland Formation is along the northern boundary of the trail system. Eight existing wells that are visible or audible to recreationists are situated near trails.

The FS has prepared a study for a motorized and nonmotorized trail system along Sauls Creek, northeast of Bayfield, near the La Plata/Archuleta County line. The FS has proposed that existing informal trails be linked and that signs and a parking lot be added to the proposed trail system. After the system is in place, it will be suitable for races and other special events. Five CBM wells are near existing trails in the Sauls Creek area.

#### 3.12.2.1.4 Hunting and Fishing

Hunting is a major recreational use of federal land in the Project Area. Big-game hunting seasons occur from late August through mid-January. Elk, deer, bear, mountain lion, and game birds are found in suitable habitats throughout the Project Area. Big game is managed by CDOW in game units. The Project Area contains portions of four game units.

A limited amount of fishing occurs on streams in the Project Area. Most fishing on the Piedra, Florida, and the Pine Rivers is in upstream reaches north of the Project Area. Existing CBM wells can affect recreational opportunities, by disturbing wildlife and by converting wildlife habitats to well pads and access roads. In addition, hunters and fishermen, as well as other recreational visitors, encounter the sight and sound of CBM wells in some areas, including NFS land. Table 3–134 summarizes the number of participating hunters and recreation days for each game unit.

**Table 3–134 Hunting in the Northern San Juan Basin Project Area**

| Game Unit | Total Hunters | | Change 1999-2000 (percent) | Total Harvest | | Percent Success | | Total Recreation Days | | Change 1999-2000 (percent) |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1999 | 2000 | | 1999 | 2000 | 1999 | 2000 | 1999 | 2000 | |
| Deer | | | | | | | | | | |
| 75 | 947 | 835 | -11.8 | 378 | 396 | 40 | 47 | 4,032 | 3,572 | -11.4 |
| 77 | 912 | 1,045 | 14.6 | 324 | 455 | 36 | 44 | 3,695 | 4,444 | 20.3 |
| 751 | 1,247 | 1,341 | 7.5 | 301 | 279 | 24 | 21 | 5,570 | 6,921 | 24.3 |
| 771 | 706 | 719 | 1.8 | 345 | 398 | 49 | 55 | 2,752 | 2,437 | -11.4 |
| Total | 3,812 | 3,940 | 3.4 | 1348 | 1528 | 35 | 39 | 16,049 | 17,374 | 8.3 |
| Elk | | | | | | | | | | |
| 75 | 3,270 | 3,124 | -4.5 | 513 | 994 | 16 | 32 | 17,100 | 14,081 | -17.7 |
| 77 | 2,044 | 2,371 | 16.0 | 225 | 617 | 11 | 26 | 10,981 | 11,055 | 0.7 |
| 751 | 4,234 | 3,760 | -11.2 | 430 | 1,073 | 10 | 29 | 23,311 | 18,108 | -22.3 |
| 771 | 1,157 | 1,152 | -0.4 | 137 | 375 | 12 | 33 | 6,996 | 5,674 | -18.9 |
| Total | 10,705 | 10,407 | -2.8 | 1305 | 3,059 | 12 | 29 | 58,388 | 48,918 | -16.2 |

Source: CDOW 2001

## 3.12.2.2 San Juan National Forest and BLM Recreation Management

The SJNF offers a wide variety of year-round, dispersed recreational opportunities in the eastern part of the Project Area. Such activities account for the largest amount of recreational uses and are projected to be the fastest-growing segment of recreation use on the SJNF. There are no developed recreation sites on the SJNF in the Project Area.

Recreational use of most BLM land in the Project Area is limited, as it consists of isolated tracts surrounded by private property and generally is not accessible by road or trail, with the exception of Grandview Ridge.

Based on the variations in types of use and the recreation areas in the Project Area, it has been divided into six distinct separate areas (Figure 3–50), as follows:

1. Grandview Ridge (BLM)
2. BLM Dispersed Tracts
3. Sauls Creek
4. Spring Creek
5. HD Mountains (Roadless Area)
6. Fosset Gulch

**Grandview Ridge**: The BLM Grandview Ridge Coordinated Resource Management Plan (CRMP) addresses increasing demands for recreation and the potential conflicts among recreation, wildlife, and mineral development. The Grandview CRMP amends the existing San Juan Field Office RMP by adding a nonmotorized-recreation emphasis to the Grandview Ridge Area, which is roughly 1,600 acres.

Nonmotorized access to Grandview Ridge is available at Big Canyon and Sale Barn Canyon, directly off U.S. Highway 160. The primary access is via Horse Gulch, north of the Project Area in Durango. The Horse Gulch Area trail system is north of Grandview Ridge and connects with the Grandview Ridge trail system. The area contains 26.4 miles of the trail system. The Southern Utes have acquired 900 acres directly east of the Grandview Ridge area and plan a commercial/residential development of more than 2,500 homes and businesses that would increase the recreational demands in the area. Travel management within the area is restricted to nonmotorized use, except access for mineral development.

**BLM Dispersed Tracts:** A number of BLM dispersed land tracts are located throughout the Project Area. A broad spectrum of dispersed recreation occurs, such as hiking, mountain biking, hunting, ATV riding, and wildlife viewing. Dispersed winter activities include cross-country skiing, snowmobiling, and snowshoeing. Numerous 4-wheel-drive roads and trails traverse the Project Area and provide opportunities for dispersed activities. Outfitters and guides engage in some dispersed uses (hunting) as well as trail uses (horseback riding). No legal access is available to the public for many of these tracts, which are open to motorized use.

**Sauls Creek:** The Sauls Creek Area is east of Bayfield and comprises about 3,800 acres. It is an important recreation area for the community of Bayfield and receives extensive motorized and nonmotorized use. There are 9 miles of designated system trails that are used year-round by recreationists. The area is also used heavily in the fall for big-game hunting, with access from Forest Roads 608, 755, and 743. The area is open to motorized use from June 1 to November 30.

**Spring Creek:** This area, southeast of Bayfield, is some 6,000 acres. Local residents use it for both motorized and nonmotorized recreation. ATV use is extensive next to the residential areas. The area is also used heavily in the fall for hunting, with access from Forest Road 537, and is open to motorized use from June 1 to November 30.

**HD Mountains Roadless Area:** This forms the backbone of the HD Mountains. There is one road corridor, FDR 756, which cuts up the middle of and to the top of the roadless area and provides access to a shut-in well and beyond. The roadless area is 9 miles long and is reached by foot or horseback from the south or north, or by hikers dispersing from FDR 756 from the top.

The HD Mountains provide a variety of dispersed recreation, primarily hunting, ATV and 4-wheel-drive use, camping, and sightseeing. Seasonal big-game hunting is the major attraction. There is a limited amount of cross-country skiing and Christmas tree cutting. There are no established trails or developed recreation sites within the HD Mountains; ATVs and other 4-wheel-drive vehicles have carved numerous tracks through parts of the area. Portions of the HD Mountains offer opportunities for backcountry recreation. Two CBM wells are operating in the HD Mountains Roadless Area.

**Fosset Gulch:** The Fosset Gulch area is east of the HD Mountains and parallels U.S. Highway 160. The area is about 7,500 acres and is reached by Forest Road 613. The area receives limited recreational use. It is open to motorized use from June 1 to November 30. Hunters mostly access and use the area on foot, horseback, and ATV. The existing road system, which is a remnant of past timber sales on the eastern flank of the HDs, gives easy access to portions of the Pargin Mountain area. The general setting is a more or less natural one, but with a low to moderate amount of road access. Past harvesting is in evidence, and those accessing the area from the south must pass by existing wells. Most hunters continue to return to the area annually, attracted by the quality of the hunt.

### 3.12.2.3 County Recreation Management

The La Plata County Comprehensive Plan, completed in 2001, is intended to incorporate and uphold the intent of the district plans and to give additional detail and guidance to the overall growth management system of La Plata County. The Parks, Recreation, and Trails Element of the county comprehensive plan focuses on recreational programming and facility needs. Recreational facilities in the unincorporated county are limited, although the demand is increasing as the population in unincorporated areas of the county has grown. Accordingly, the primary goal of the comprehensive plan (Goal 11.1) is to ensure that the needs of residents for recreational programs and facilities are met as the county grows.

The Archuleta County Community Plan, adopted by the Planning Commission in March 2001, includes policies to maintain the necessary level of public facilities and services, including recreation, to serve the population adequately. Most of Archuleta County within the Project Area is federal land administered by the

SJNF. No existing CBM wells are on private land within the Project Area in Archuleta County.

The La Plata County Open Space Conservancy, a private, nonprofit land trust, has been granted parcels of private land north and east of Bayfield as La Plata County Open Space Conservancy Protected Properties. Agricultural landowners donated the land for wildlife conservation easements, in return for inheritance and other tax benefits. The open-space properties retain wildlife habitats and the natural setting and enhance the overall rural ambience of the Project Area. The open-space properties act as visual buffers around and between developments, and protect view corridors along county roads and state highways. Two CBM wells are operating in open-space parcels.

## 3.12.3 Environmental Consequences

### 3.12.3.1 Recreation Impacts

Recreational impacts would occur over the life of the proposed CBM development, because undisturbed areas currently used for recreation would be used for CBM facilities. Specifically, impacts on recreation would occur if

- CBM development alters the natural setting or character of an area used for recreation;
- CBM-related construction, operation, and maintenance disrupt recreation as a result of noise, dust, traffic, and increased human activity;
- Recreational resources, such as designated and informal trails, are altered or displaced by CBM well pads or roads;
- CBM development increases vehicle access into previously roadless or inaccessible areas; or
- CBM development is incompatible with federal, state, or county objectives for recreation in the Project Area.

#### *3.12.3.1.1 Alternative 1 — Proposed Action*

*Recreational Use/General*

The primary effect of CBM development on recreation would be impacts on trails and roads. The landscape in the Project Area ranges from rural on private land in La Plata County to a natural-appearing, undeveloped roadless area on NFS land in the eastern half. Oil and gas operations have added an industrial component to the landscape, primarily on federal, state, and private land in La Plata County. Additional wells would increase this industrial component of the landscape and add new sources of vehicle traffic and noise that would diminish the recreational experience and alter the rural ambience sought by recreationists. The gas well access roads would be gated and closed to public motorized use.

Local residents value the federal land for recreation because of its proximity and the relative solitude that can be achieved within a short distance from their home. The solitude and natural setting now experienced on this public land would be most impaired by the project during the 5-year construction period. Recreationists would encounter wells and roads where there had been, for the most part, natural-appearing landscapes.

In partially developed portions of the Project Area, the number of wells would double, further altering the natural appearance of the landscape and the backcountry ambiance of the area. Access to the SJNF would be altered by development of an extensive road system. The opportunity for solitude and ability to recreate in an undeveloped landscape would be lost over much of the Project Area, and this impact would continue through the life of the project. The views from designated trail systems and informal trails used by mountain bikers, hikers, horse riders, OHV users, hikers, cross-country skiers, photographers, and wildlife viewers would be altered by construction of pads and roads. In addition, recreationists would experience minor conflict with increased traffic from project vehicles and more noise and airborne dust than they encounter now.

Construction-related noise would reduce the quality of the recreational experience in general whenever a recreationist is near construction. Noise levels could increase in the long term in localized areas, as well, because of CBM compressors and continued use of pumps. Long-term impacts would include the potential removal of land from existing recreational uses, the visual and audible intrusion of facilities on recreational activities, and increased access to public and private land from new access roads in the Project Area.

### Developed Recreation

Three privately owned campgrounds next to U.S. Highway 160 are in the Project Area. Well windows are adjacent to three campgrounds: the Cottonwood Camper Park, the Durango East KOA campground, and the Riverside RV Park; all are reached from Highway 160. The sights and sounds of the increased well construction traffic and drilling during the construction period could distract campground visitors. After well installation is completed, project-related trips for operations and maintenance would not result in a noticeable increase in traffic on the highway.

The long-term impact of CBM facilities near the campgrounds would include the visual impact from the gas facilities and the possibility that the well facilities would be audible. One well window would be in the proposed Cedar Hill golf course and subdivision. For golfers and residents, construction and operation of a well and ancillary facilities would be an audible and visual intrusion. The golf course and subdivision have not yet been constructed, however, and the well would precede construction.

For some users of the Grandview Ridge and Sauls Creek trail systems, the visual and audible intrusion of construction and the operation of CBM facilities over the life of wells developed within areas of the trail systems would reduce the quality of their recreational experience. The Grandview Ridge trails are southeast of Durango on BLM and private land in the western portion of the Project Area. The Sauls Creek trail system is northeast of Bayfield, near the La Plata/Archuleta

County line. One well window is within the Grandview Ridge Trail System. There are four well windows on private land and eight known well locations on NFS land proposed for the vicinity of the Sauls Creek trail system.

### Dispersed Recreation

Dispersed recreation in the Project Area includes hunting, fishing, hiking, bicycling, sightseeing, and camping. Dispersed recreation is not a primary use of most state or private land within the boundary of the Project Area. However, we would expect a reduction in the numbers of hikers, hunters, campers, and mountain bikers attracted to backcountry settings, and sightseers exploring backcountry roads. The absolute number of hunters would not be altered in an appreciably, however, because the expanded road system would increase ease of foot and horseback access and attract additional use to the area.

Fishing is a minor use of streams in the Project Area; most fishing is in the upper reaches of streams north of the Project Area. Thus, there would be minimal impacts on fishing from project construction and operations.

### Impacts on BLM/FS Recreational Areas and Travel Management by Proposed CBM Construction and Operation

CBM development, as proposed, would entail construction of new roads into some areas that were not previously accessible by road. Currently, the BLM and USFS allow off-road, cross-country travel by motorized vehicles. The increased access associated with new roads would result in additional impacts on wildlife and physical resources on the public land. The current travel management policy would be changed to mitigate these impacts somewhat in Alternatives 1, 1A, 1B, 2, and 3, by restricting motorized use to designated travel routes only.

Currently, motorized travel on BLM lands in the Study Area is unrestricted. NFS lands in the Study Area are currently designated as Travel Management Area C, meaning that the area is closed year-long to all motorized vehicles except OHVs, which can travel unrestricted in the area from approximately June to November each year. The existing FS road system and travel management are shown on Figure 3–51.

The travel management restrictions for Alternatives 1 through 3, which are mitigation measures for soils (Section 3.7), vegetation (Section 3.8), and wildlife (Section 3.9) would limit motorized use to designated roads and trails on NFS lands. These restrictions would change the designation of the FS Travel Management Area from “C” to “A.” Thus, all motorized travel would be prohibited yearlong, except on designated roads and trails, which would be open with seasonal restrictions. The gas well access roads would be gated and closed to motorized travel yearlong, except gas roads that are designated travel routes. The operators would be allowed to use the roads as necessary to maintain the facilities, in compliance with seasonal restrictions and resource mitigation measures. No change in travel management is proposed for BLM land at this time.

This change in travel management, as well as the potential impacts to recreation areas within the Project Area, is reflected in the environmental-consequences discussion that follows. The proposed FS road system and travel management policy are shown on Figure 3–52. Table 3–135 shows impacts to the six recreation areas by alternative.

**Grandview Ridge:** Motorized recreation use would continue to be prohibited. There would be no wells or associated access roads in the area. Therefore, there would be no effect on recreational use of the area from construction and operation of CBM facilities.

**BLMFS Dispersed Tracts:** Eighty-eight facilities would be developed on dispersed tracts. Motorized travel would be managed as described above. Most of the BLM dispersed public land is already developed for oil and gas. Recreationists would continue to use these areas in the same numbers because they are accustomed to a developed landscape partially dominated by gas facilities.

**Sauls Creek:** Motorized use would be restricted to designated roads and trails, as described above. Thirty-four facilities would be developed. With the exception of designated routes, the gas well access roads would be gated and closed to public motorized use. The quality of the recreational setting would be reduced for users of the Sauls Creek trail system by the visual and audible intrusion of construction and operation of CBM facilities near the trail system. Wildlife movement may be impacted but not to the degree that there would be a reduction of big game for hunters. Recreationists would continue to use the area in moderately high numbers to take advantage of proximity to Bayfield.

**Spring Creek:** Motorized travel would be limited to designated roads and trails, as described above. Twenty-seven facilities would be developed within Spring Creek. The access roads to the gas wells would be gated and closed to public motorized use, except for certain routes. The types of recreation impacts that we expect for Sauls Creek would also apply to Spring Creek, because of proximity to population centers. That is, many recreationists would react negatively to the increased development and density of wells, but would continue to use the area as they have traditionally because of proximity Bayfield.

**HD Mountains Roadless Area:** Motorized travel would be restricted to designated roads and trails, to decrease impacts on soils, vegetation, and wildlife. Fifty-eight facilities are proposed for NFS land within the HD Mountains Inventoried Roadless Area. Except for the main Spring Creek Road, the access roads to the gas wells would be gated and closed to public motorized use. The proposed facilities would obviously modify the natural environment.

Access to the HD Mountains Roadless Area would be from the top and from continuation of the road system from FD Roads 743 and 756. Most of the actual backbone of the HD Mountains Roadless Area would be developed at a density of one to two well pads and about 1 mile of road per section. Portions of the area that makes up the west flank of the roadless area would remain undeveloped.

## Table 3–135 Proposed CBM Facilities in Recreation Areas

| Alternative/Recreation Area | Number of Facilities[1] | Long Term Facility Disturbance (acres) | Roads (miles) | Long Term Road Disturbance (acres) |
|---|---|---|---|---|
| Alternative 1 | | | | |
| Grandview Ridge (BLM) | 0 | 0 | 0 | 0 |
| BLM/FS Dispersed Tracts | 88 | 91 | 18 | 56 |
| Sauls Creek | 34 | 38 | 10 | 30 |
| Spring Creek | 27 | 32 | 10 | 30 |
| HD Mountains | 58 | 67 | 38 | 115 |
| Fosset Gulch | 80 | 84 | 42 | 128 |
| Total[2] | 287 | 313 | 118 | 359 |
| Alternative 1A | | | | |
| Grandview Ridge (BLM) | 0 | 0 | 0 | 0 |
| BLM/FS Dispersed Tracts | 88 | 91 | 18 | 56 |
| Sauls Creek | 32 | 47 | 6 | 18 |
| Spring Creek | 21 | 36 | 6 | 19 |
| HD Mountains | 37 | 64 | 29 | 88 |
| Fosset Gulch | 56 | 93 | 35 | 105 |
| Total[2] | 234 | 331 | 94 | 286 |
| Alternative 1B | | | | |
| Grandview Ridge (BLM) | 0 | 0 | 0 | 0 |
| BLM/FS Dispersed Tracts | 88 | 91 | 18 | 56 |
| Sauls Creek | 32 | 49 | 6 | 18 |
| Spring Creek | 13 | 24 | 5 | 17 |
| HD Mountains | 17 | 64 | 16 | 48 |
| Fosset Gulch | 20 | 58 | 17 | 50 |
| Total[2] | 170 | 286 | 62 | 189 |
| Alternative 2 | | | | |
| Grandview Ridge (BLM) | 13 | 13 | 4 | 11 |
| BLM/FS Dispersed Tracts | 177 | 180 | 44 | 133 |
| Sauls Creek | 49 | 53 | 16 | 50 |
| Spring Creek | 58 | 65 | 25 | 75 |
| HD Mountains | 104 | 113 | 61 | 185 |
| Fosset Gulch | 113 | 117 | 54 | 163 |
| Total[2] | 514 | 542 | 203 | 617 |
| Alternative 3 | | | | |
| Grandview Ridge (BLM) | 0 | 0 | 0 | 0 |
| BLM/FS Dispersed Tracts | 88 | 91 | 18 | 56 |
| Sauls Creek | 33 | 35 | 9 | 28 |
| Spring Creek | 24 | 26 | 10 | 30 |
| HD Mountains | 0 | 0 | 0 | 0 |
| Fosset Gulch | 76 | 78 | 40 | 121 |
| Total[2] | 221 | 230 | 78 | 235 |
| Alternative 4 | | | | |
| Grandview Ridge (BLM) | 0 | 0 | 0 | 0 |
| BLM/FS Dispersed Tracts | 86 | 88 | 18 | 56 |
| Sauls Creek | 24 | 26 | 8 | 25 |
| Spring Creek | 27 | 29 | 15 | 45 |
| HD Mountains | 24 | 24 | 25 | 75 |
| Fosset Gulch | 29 | 30 | 24 | 73 |
| Total[2] | 190 | 197 | 91 | 275 |
| Alternative 5 | | | | |
| Grandview Ridge (BLM) | 0 | 0 | 0 | 0 |
| BLM/FS Dispersed Tracts | 78 | 81 | 18 | 53 |
| Sauls Creek | 18 | 20 | 4 | 13 |
| Spring Creek | 7 | 7 | 2 | 5 |
| HD Mountains | 0 | 0 | 0 | 0 |
| Fosset Gulch | 18 | 18 | 15 | 47 |
| Total[2] | 121 | 126 | 39 | 118 |

Note:

1. The facilities include well pads, water disposal wells, compressors, and gathering stations.
2. Totals for numbers of facilities in Recreation differ from Chapter 2 numbers because they do not include disposal wells and compressors located outside of the Project Area that are part of the alternative actions (see Tables 2–1, 2–6, 2–7, 2–8 2–13, 2–17, and 2–18).

Alternative 1 would impact recreational use of the HD Mountains Roadless Area. The heart of the area would now be accessible to those who are attracted to hiking sparsely used roads. Recreationists attracted unaltered backcountry landscapes may be displaced. Recreationists who reach Ignacio Creek from the south would encounter a developed landscape, where previously the area was rugged backcountry.

Recreational use through the south end of the HD Mountains Roadless Area by horseback clubs, hunters, and individuals would also be affected, because of the change in access and character of the landscape. Car campers would continue to access the area from FDR 756 and would be as limited in the extent of their access as today. Many of the traditional backcountry uses of the southern portion of the HD Mountains Roadless Area would be diminished by the proposed development. A large part of the north and west end of the HD Mountains Roadless Area would remain unaltered, however, and would continue to provide the same types of backcountry recreation that are available now.

**Fosset Gulch:** The travel management policy would be changed to limit motorized use to designated roads and trails. Eighty facilities would be developed. The quality of the recreational setting would be reduced for users of the area by the visual and audible intrusion of construction, and the operation of CBM facilities over the life of wells developed within the area.

The resulting landscape of Fosset Gulch would be extensively roaded over the entire area. Most square-mile sections would have, on average, 1 mile of new access road, where generally road access previously did not exist. This change in access and the physical characteristics of the area from generally undeveloped to highly developed would alter the pattern of the area's recreational use and the quality of the recreation experience accordingly.

The number of hunters, the principal dispersed-recreational use of NFS land in this portion of the Project Area, would not change appreciably. The expanded road system would increase ease of access for hunters on foot or on horseback and attract new hunters. However, the change in landscape character may discourage others who appreciate a more remote backcountry setting. Hunters would no longer experience a true backcountry setting.

The area receives some general ATV use now, which probably would continue. Although off-road use would no longer be available, more roads and trails would be available for motorized travel (Figure 3–52). The few hikers who use the area may or may not continue to return. Those who are attracted to wide-open vistas of undeveloped area would generally be disappointed by the area's alteration and go elsewhere. Car campers would continue to use small pulloffs and spurs off FDR 613, because Alternative 1 would not affect these pulloffs.

### *County Recreation Management*

The Florida Mesa Land Use Plan (La Plata County Planning Department 1998), which contains recommendations on land use for the western part of the Project Area, has identified the need for nonagricultural open space, wildlife habitat, and parks. An objective of the plan is to work with the state and federal governments to maintain and improve public-land open space and recreational access to public land. A second objective is to designate "school sections" (generally sections 16 and 36 of each township) as open space. Five production wells and two compressors are situated on school sections. County objectives for open space may, therefore, conflict with the proposed well locations.

#### 3.12.3.1.2 Alternative 1A

On the west side of the Project Area, the recreation impacts would be the same as described for Alternative 1. On the east side, SJNF impacts would be reduced because fewer roads and well pads would be constructed in the HDs. Compared with Alternative 1, Alternative 1A would require 30 percent fewer well pads (211 vs. 273) and 20 percent less road constructed (94 vs. 118). The physical and visual impacts of implementing Alternative 1A would be commensurately less than Alternative 1. Motorized travel would be restricted to designated routes throughout the NFS lands in the project area, similar to Alternative 1.

**Grandview Ridge:** The impacts on all recreational uses would be the same as described for Alternative 1.

**BLM Dispersed Tracts:** The impacts on all recreational uses would be the same as described for Alternative 1.

**Sauls Creek:** Horizontal wells would be drilled from existing well pads, reducing the number of new well locations by about 6 percent, compared with Alternative 1. The long-term impacts on recreation would remain essentially unchanged from the impacts of current development. During the construction phase of the project (5 years), there would be minor conflicts between increased industry traffic and the general public's use of roads in Sauls Creek, when drill rigs and associated equipment would be in use within the area.

**Spring Creek:** There would be 32 new facilities constructed in this area. This increase would impact recreation in ways generally similar to those described for Alternative 1. Compared with Alternative 1, though, Alternative 1A would require 6 percent fewer facilities and associated roads. Thus, the overall impact of Alternative 1A would be less than is portrayed for Alternative 1. Most of the recreational use of the area is by residents of the Spring Creek/Bayfield areas. We anticipate that the overall level of recreational use of the area would remain unchanged.

**HD Mountains Roadless Area:** Thirty-seven facilities are proposed for Alternative 1A, about 36 percent fewer than proposed for Alternative 1. Impacts on the HD Mountains Roadless Area would be similar as described for Alternative 1, but of a lesser magnitude.

**Fosset Gulch:** Alternative 1A would develop much of the Fosset Gulch area, but the number of facilities would be close to 30 percent less, and associated roads about 11 percent greater, than Alternative 1. Recreational impacts would be similar to those described for Alternative 1. The road system would ease access to the area for those on foot or horseback. Visually, however, the landscape would have a strong industrial component, which may reduce the quality of the recreation experience for those using the area, primarily hunters.

### 3.12.3.1.3 Alternative 1B

Alternative 1B would involve drilling long-reach horizontal wells in the HD Mountains Roadless Area and the Fosset Gulch and Spring Creek portions of the Project Area. Because this method would involve drilling three to four downhole locations from a single well pad, the number of well pads and associated roads would be significantly reduced in the HD Mountains Roadless Area, in Fosset Gulch, and in Spring Creek. Recreation impacts would be reduced commensurately. CBM development, and thus impacts, on the west side of the Project Area and Sauls Creek would be as described for Alternative 1. On BLM and NFS land, motorized travel would be restricted to designated routes.

**Spring Creek:** There would be 13 facilities constructed under Alternative 1B, about 52 percent less than for Alternative 1. The impact to recreation would be similar to those described for Alternative 1, but would be reduced in magnitude.

**HD Mountains Roadless Area:** There would be 17 facilities constructed in the Roadless Area under Alternative 1B, considerably less than proposed for Alternative 1. Alternative 1B would, however, still require expansion of the road system from FSR-756 down over the spine of the HDs, to access drill pads. This road and associated development on the east and south end of the Roadless Area would have much the same recreation impact as described for Alternative 1. The roadless area, however, would appear less developed to recreationists, due to fewer wells and roads constructed under Alternative 1B.

**Fosset Gulch:** Alternative 1B would require significantly fewer well pads and roads to develop Fosset Gulch CBM than Alternative 1. Thus, the visual intrusion of CBM development would be significantly less. The resulting road system would be roughly equivalent to the total mileage of low-standard and primitive roads that now exists in the area. So ease of travel by foot or horseback would remain about the same. Hunting opportunities, the primary use of the area, would remain about the same, also. Motorized travel would be restricted to designated routes, however, limiting the travel of ATVs to a small portion of the overall Fosset Gulch area.

### 3.12.3.1.4 Alternative 2

Implementation of this alternative would increase development and land disturbance, as well as vehicle traffic, when compared with Alternative 1. Alternative 2 involves the greatest impact on recreational opportunities in the Project Area, compared with the other four alternatives.

**Grandview Ridge:** Thirteen facilities would be developed near the Grandview Ridge trail system. Consequently, the sights and sounds of well construction and operation would affect the entire system of trails over the life of the project. The quality of the recreational experience would be diminished by the maximum-development alternative.

**BLM Dispersed Tracts:** Motorized travel would be limited to designated roads and trails. There would be 177 facilities developed on BLM tracts. The access roads to the gas wells would be gated and closed to public motorized use. The quality of the recreation setting would be diminished similar to the impact described for Alternative 1.

**Sauls Creek:** Motorized travel would be restricted to designated roads and trails. Forty-nine new facilities would be developed. The access roads to the gas wells would be gated and closed to public motorized use. The resulting impacts of CBM development would be greater than described for Alternative 1.

**Spring Creek:** The overall level of CBM development would be significantly greater than is described for Alternative 1, as more than twice the number of facilities is proposed for Alternative 2. There would be a significant change in the natural environment that would reduce the aesthetics of the entire area. Consequently, the quality of the recreational setting would be reduced for many users of the Spring Creek area by the visual and audible intrusion of construction and the operation of CBM facilities over the life of wells developed within the area.

Some recreationists would abandon the area for less developed landscapes near the SJNF. Others would continue to use the area, possibly because of the opportunities presented by an expanded road system, but their recreation would occur in a highly developed landscape. Motorized travel would be restricted to designated roads and trails.

**HD Mountains Roadless Area:** Motorized use of the area would be limited to designated roads and trails, moderating the impacts of motorized vehicles on the physical environment. There would be 104 facilities constructed on NFS land within the HD Mountains Inventoried Roadless Area, an increase of 79 percent from Alternative 1. The access roads to the gas wells would be gated and closed to public motorized use.

In terms of overall impact, most of the backbone of the HD Mountains Roadless Area would be developed with well pads and about 1 mile of road per section. A small portion of the area that makes up the west flank of the HD Mountains Roadless Area would remain undeveloped.

The heart of the Roadless Area, running up and down the spine of the mountains, would now be accessible and more readily reached by hikers and others nonmotorized users. The road system would attract new use, but travel would be restricted. Backcountry recreationists would be displaced. Recreational use through the southern end of the HD Mountains Roadless Area by horseback clubs, hunters, and individuals would also diminish, because of the change in access and character of the landscape. Car campers would reach the area from FDR-756, but would continue to be as limited in the extent of access as today because of road closures. Many of the traditional backcountry uses of both the northern and southern portion of the HD Mountains Roadless Area would be diminished by the proposed development.

**Fosset Gulch:** Motorized travel would be restricted to designated roads and trails. Alternative 2 would involve constructing 113 facilities, which is 41 percent more than Alternative 1. The quality of the recreational experience would be reduced for many users by the visual and audible intrusion of construction and the operation of CBM facilities over the life of wells developed within the area. The resulting landscape would be extensively roaded. All square-mile sections would have, on average, 1 mile of new access road, where generally road access previously did not exist. This change in access and the physical characteristics of the area, from generally undeveloped to highly developed, would alter the patterns of the area's recreational use and the quality of the recreation experience.

The number of hunters, the principal dispersed-recreational users of NFS land in this portion of the Project Area, would not be altered appreciably. On balance, the change in access may attract a different group of hunters, while displacing others. Hunters would no longer experience a backcountry setting.

#### *3.12.3.1.5 Alternative 3*

Alternative 3 includes all of the environmental effects described for Alternative 1, but differs in that well development would be eliminated in the HD Mountains Inventoried Roadless Area. Under this alternative, the impacts on all recreational uses outside the HD Mountains Roadless Area would be the same as were described for Alternative 1.

Alternative 3 would eliminate CBM development from the HD Mountains Inventoried Roadless Area. Motorized travel would be restricted to designated roads and trails. This limitation would decrease the impacts on the physical environment. Except for the change in travel management policy, this alternative would not generate new or different recreation impacts in the HD Mountains Roadless Area.

#### *3.12.3.1.6 Alternative 4*

Alternative 4 represents a pattern of gas development on federal land in the Project Area that is similar to Alternative 1 in the western side of the Project Area, but is of lesser intensity in the HD Mountains, Fosset Gulch, and Pargin Mountain areas. The current travel management designations would not change from Alternative 1.

**Grandview Ridge:** The impacts on all recreational uses would be the same as described for Alternative 1

**BLM Dispersed Tracts:** The impacts on all recreational uses would be similar to described for Alternative 1. The travel management policy for Alternative 4 would remain the same as current, allowing motorized travel off roads or trails.

**Sauls Creek:** Alternative 4 would be similar to those described for Alternative 1. Alternative 4 would result in 29 percent fewer facilities in Sauls Creek as compared to Alternative 1. The travel management policy for Alternative 4 would not limit motorized use to designated roads and trails as in Alternatives 1 through 3.

**Spring Creek:** Alternative 4 would have the same impacts on recreation that were described for Alternative 1.

**HD Mountains Roadless Area:** Alternative 4 would result in the same impact on recreational opportunities in the HD Mountains as Alternative 1. Twenty-four facilities would be developed and land in the HD Mountains. Though there would be les wells developed when compared to Alternative 1, the location of wells would result in much the same impact as Alternative 1.

**Fosset Gulch:** The alternative differs from Alternative 1 in that 64 percent fewer facilities would be developed and less land would be disturbed temporarily or removed from existing uses during the life of the project. Since fewer wells are envisioned and fewer acres would be disturbed, the impacts on existing recreational uses should be somewhat less than described for Alternative 1.

### 3.12.3.1.7 Alternative 5 — No Action

Under the No Action Alternative, CBM development would continue on private and state leases but would not be authorized at this time on federal leases in the Project Area. This alternative results in recreation impacts on state and private land similar to the Proposed Action. Because no additional development of federal minerals would occur, the resulting federal land impacts would be significantly less than the other action alternatives.

**Grandview Ridge:** Under this alternative, the impacts on all recreational uses would be the same as were described for Alternative 1.

**BLM Dispersed Tracts:** Alternative 5 would not alter or change the type of, location of, or access to recreation that currently takes place on BLM dispersed tracts. The travel management policy for Alternative 5 would continue to allow motorized use on the BLM land.

**Sauls Creek:** Alternative 5 would slightly alter recreational access and the recreation setting that currently exist in the Sauls Creek area, as a result of additional CBM development on private land. The travel management policy for Alternative 5 would continue to allow motorized use within the area, both on and off road or trail. Recreational use of the area would not change from the patterns and types of recreation currently experienced.

**Spring Creek:** This alternative differs from Alternative 1 in that far fewer wells would be developed and fewer acres of land would be disturbed temporarily or removed from existing uses during the life of the project. Since fewer wells are envisioned and fewer acres would be disturbed, the impacts on existing recreational uses should be less than the proposed action. Recreationists would not encounter additional development on the SJNF.

The travel management policy for Alternative 5 would continue to allow motorized use on NFS land.

**HD Mountains Roadless Area:** Alternative 5 would result in no new CBM development in the HD Mountains Inventoried Roadless Area. Motorized use, both on and off roads or trails on NFS and BLM land, would continue to be permitted. The patterns of recreational use would remain unchanged from those currently occurring.

**Fosset Gulch:** There would be additional development on private and state tracts near Fosset Gulch Road. Overall, however, recreational use of the area would not change.

## 3.12.4 Cumulative Effects

The cumulative effects analysis area includes the area where oil and gas development has occurred and will take place within the bounds of the Southern Ute Reservation and the Project Area. A review of the SUIT final EIS for oil and Gas Development (2002) indicated that no measurable impacts on recreational resources were expected from construction and operation of wells and associated facilities. There were no effects on recreation opportunities from other reasonably foreseeable oil and gas development in the SUIT Study Area. Significant portions of the SUIT Study Area are not accessible by the public.

Cumulative CBM development in the Project Area consists of existing CBM facilities and the facilities proposed for each alternative. Existing and proposed CBM facilities that affect developed recreational facilities are within visual or audible distance from the recreational facilities. The additive visual impact of proposed well development in the Project Area and the SUIT study area would result in increased degradation of the scenic resource of the cumulative-impacts area. Ongoing CBM development and other land development that occurs with increasing population growth would result in an overall degradation of the natural character and opportunities for solitude that draw many recreationists to the region.

## 3.12.5 Mitigation and Monitoring

Unless otherwise stated, the following measures will be funded by the Companies.

- Change vehicular travel management throughout the SJNF portion of the Project Area from the current policy that allows motorized vehicle travel off roads or trails to management that restricts motorized travel to designated roads and trails only. Off-road or off-trail motorized travel would be prohibited. (Applies to Alternatives 1 through 3.)
- Do not develop wells on trails that cross well windows in the Grandview Ridge and Sauls Creek trail systems. Situate wells to make use of existing terrain and vegetation to screen them from the views of visitors who use the trails or roads that access the trails. Where possible, avoid building well access roads or CBM facilities across or near trails in the Grandview Ridge and Sauls Creek areas.

## 3.12.6 Conformance to Existing Plans and Policies

### 3.12.6.1 Conformance with Federal Land Use Plans

The LRMP for the SJNF (FS 1983) establishes direction, standards, and guidelines for managing recreation resources. The standards and guidelines specify the types of recreation that are compatible with, or emphasized in, each Management Area of the SJNF. Each Management Area presents a unique combination of multiple uses.

The SJNF portion of the Project Area contains Management Areas 2A, 3A, 4B, 5B, and 6B. Each of these allows for both motorized and nonmotorized recreation. Within Management Area 3A, motorized recreation must be restricted to designated roads or trails. Alternatives 1, 1A, 1B, 2, and 3 change the travel management policy for the SJNF portion of the Project Area, prohibiting off-road motorized recreation and restricting motorized use to designated roads (Figure 3–52). Current Management Direction allows motorized recreation both on- and off-road. This change in travel management is compatible with direction for recreation management within the five different Management Areas.

Management direction of BLM tracts would not change and would continue to be in conformance with the RMP.

## 3.12.7 Unavoidable Adverse Effects

Unavoidable adverse effects depend on the perspective and interest of recreationists. Some recreationists—particularly hunters—would be adversely impacted by the restriction of motorized recreation to designated routes. Others who engage in backcountry recreation within the HDs would find a landscape that is more developed and incompatible with primitive backcountry recreation.

The change in landscape character would be greatest in the HD Roadless Area and Fosset Gulch, both of which currently provide backcountry settings. The duration of this change would be at least 25 years, after which well decommissioning and well pad and road obliteration would begin to restore the backcountry landscape. Alternative 2, followed in descending order by Alternatives 1, 1A, 3, 4, 1B, and 5, would have the greatest impact on dispersed recreation.

Alternatives 1, 2, 4, and 1A would have the greatest impact on recreation and physical setting within the HD Roadless Area; Alternatives 1B, 3, and 5 would have the least impact.

## 3.12.8 Irreversible and Irretrievable Effects

No irreversible effects would occur. However, primitive backcountry opportunities would be irretrievably affected for the life of the project and beyond. Assuming reclamation of most facilities following project completion, the landscape would slowly revert to pre-project condition, with recreation settings similar to those that currently exist.

# 3.13 Transportation

## 3.13.1 Issues

*Issue 12: The effects of additional CBM development on transportation and roads.*

The following are specific facets of this issue:

- Will new roads provide access to new areas, leading to increased poaching, illegal woodcutting, disturbance of cultural sites, and disturbance to wildlife?
- Will new roads provide access for dirt bikes, four-wheelers, ATVs, and snowmobiles in what is now a roadless area?
- Will gas industry traffic increase, and how will that affect public safety?
- How will industry vehicles affect road surfaces? Will maintenance levels increase? Are road maintenance agreements already in place, and are they enforced?

## 3.13.2 Affected Environment

The transportation network that serves the Project Area consists of federal and state highways, county roads, NFSRs, and BLM roads. Workers and vehicles that haul equipment and supplies to the Project Area would use this network.

### 3.13.2.1 Public Road and Highway Network

U.S. Highway 160 is the primary east-west transportation route through La Plata and Archuleta Counties. It links the communities of Durango and Bayfield east to Interstate 25 along the Front Range of Colorado and west to Utah and Arizona. U.S. Highway 550 and State Route 172 extend south from U.S. Highway 160 through the Southern Ute Indian Reservation and into New Mexico. State Route 151 connects U.S. Highway 160 with communities on the Southern Ute Indian Reservation and with the Navajo State Recreation Area. Several smaller paved and unpaved county roads provide access from these primary highways to public and private lands in La Plata County.

The Project Area does not contain any roads maintained by Archuleta County. Most land within the Archuleta County portion of the Project Area is within the Columbine Ranger District of the SJNF. Therefore, with the exception of U.S. Highway 160 and State Route 151, roads within the Project Area in Archuleta County are NFSRs maintained by the SJNF.

Access to existing well sites in the Project Area is from private, county, BLM, and NFS roads that connect with the highway system. La Plata County roads also provide access to residential subdivisions and to isolated rural residences that are located throughout and close to the Project Area. In addition to the network of public roads, an estimated 58 miles of access roads service existing CBM and non-CBM wells on federal, state, and private lands in the Project Area. The average length of access roads to existing wells is 1,100 feet. Some of these access roads are closed to public use.

### 3.13.2.2 Federal and State Highways

Annual Average Daily Traffic (AADT) counts for U.S. Highway 160 were obtained from the Colorado Department of Transportation (CDOT). AADTs consist of the annual average of weekly traffic counts calculated from Sunday through Saturday. Table 3–136 provides a summary of current highway conditions, including counts for the stations in the Project Area and a description of the conditions of surface roads.

A Southwest Transportation Planning Region (TPR) transportation system inventory (TSI) concluded that the surface conditions of the regional highway system, including roadways in the Project Area, are generally poor to fair, with large increases in annual daily traffic projected for the next 20 years. The inventory describes existing transportation features, including roadways, trailways, aviation facilities, freight corridors, bicycle and pedestrian corridors, and other transportation facilities.

Three bridges on U.S. Highway 160 within the Project Area are functionally obsolete or are structurally deficient. The bridge over the Florida River, in the western part of the Project Area, is functionally obsolete, as is the bridge over the Los Pinos River overflow. The bridge over the Los Pinos River, on the west side of Bayfield, is structurally deficient.

Existing traffic related to CBM travels on U.S. Highway 160 to reach CBM wells and compressors. There is no discernible impact to daily traffic from CBM vehicle trips, as shown in Table 3–137.

**Table 3–136 1998 Annual Average Daily Traffic for U.S. Highway 160 in the Northern San Juan Project Area**

| Highway Number | Mileposts | Length (Miles) | AADT | Portion Trucks (percent) | Segment Description | Condition | Bridges |
|---|---|---|---|---|---|---|---|
| 160A | 86.603 to 101.386 | 16.189 | 10,432 | 10.26 | Junction SH 3 N to Junction U.S. 160 Bayfield Business Loop | Poor to good | Florida River Bridge – functionally obsolete |
| 160A | 103.176 to 103.624 | 14.345 | 4,228 | 13.77 | Road NW (Colorado Road 501) to Junction U.S. 160 Bayfield Business Loop | Poor to fair | (1) Los Pinos River Overflow – functionally obsolete<br>(2) Los Pinos River Structurally Deficient |
| 160E | 0.563 to 1.558 | 1.889 | 1,979 | 6.69 | Road N (Colorado Road 509) to Road NW (Colorado Road 501) – through Bayfield | Poor to fair | None |
| 160A | 103.624 to 117.6 | 17.769 | 4,134 | 13.85 | Junction US160 Bayfield Business Loop to Road SE (Colorado Road 7.3) | Poor to fair | None |

Notes:

1. Four or more axles-single trailer, 7 or more axle multi-trailer
2. Buses through 4 or fewer axles, single-trailer

Source: CDOT 2001

**Table 3–137 Highway Traffic Volume and Level of Service**

| U.S. Highway 160 segments | 1998 Daily Volume | 2020 Daily Background Volume | Existing Daily CBM Vehicle Trips for Wells & Compressors | Percent of 1998 Daily Volume from CBM Trips |
|---|---|---|---|---|
| U.S. 160 - SH3 to Bayfield Bus. Loop | 10,432 | 17,507 | 47 | <1 |
| U.S. 160 Business Loop | 1,979 | 2,703 | 1 | <1 |
| U.S. 160 - CR501 E. to county line | 4,134 | 4,021 | 19 | <1 |

Source: Southwest Regional Transportation Planning Commission 1999

Movement of freight is limited in La Plata and Archuleta Counties by the mountainous terrain and by seasonal road hazards. U.S. Highways 160 and 550 are, however, part of the hazardous materials route designated by CDOT.

The highest accident rates that resulted in injuries or fatalities on U.S. Highway 160 occurred near Bayfield in the years between 1990 and 1996. The accident rate was 2 or more injuries per million vehicle miles traveled (VMT). No high rates of fatalities occurred along this stretch of the highway during the same period. Instead, most accidents along the highway resulted in damage but no injuries or fatalities. The majority of these accidents occurred east of the intersection of U.S. Highways 160 and 550 and on the stretch of U.S. Highway 160 through Durango. High accident rates that resulted in injuries or fatalities between 1990 and 1996 were not reported for any other location along U.S. Highways 160, 172, or 550.

Recreational and competitive bicyclists as well as bicycle commuters use the highways and the La Plata County Road system. The La Plata County Comprehensive Traffic Study has defined the network of bicycle routes in the county (La Plata County Planning Department 1999). Bicycle routes that in the Project Area are described in Section, 3.12.2.1.2 – Dispersed Recreation.

### 3.13.2.3 County Roads

La Plata County developed a comprehensive traffic study (1999) to outline a coordinated strategy to manage and improve the county transportation system for the next 20 years. Phase A of the study surveyed existing road conditions and consisted of information on traffic accidents, a roadway data inventory (signing, striping, and road alignment), speed analysis, and traffic volume counts for selected locations throughout the county. Table 3–138 describes the types of road surfaces and lengths for local and collector roads in the Project Area.

County roads in the Project Area include paved and gravel surfaces. Paved roads are all-weather asphalt with excellent access. Gravel roads are constructed with aggregate material and designed drainage. There are nearly 80 miles of paved and graveled roads in La Plata County throughout the Project Area (Table 3–138).

The TSI identified a bridge on La Plata County Road 234 that crosses the Florida River as functionally obsolete. No other bridges on county roads within the Project Area have been identified as functionally obsolete or structurally deficient.

## Table 3–138 Existing Conditions of La Plata County Roads

| Route Name | Current Road Classification | Surface Type | Length in Project Area (miles) |
|---|---|---|---|
| 213 | Local | Gravel | 1.39 |
| 220 | Local | Asphalt | 1.78 |
| 221 | Local | Gravel | 1.05 |
| 222 | Local | Asphalt | 1.13 |
| 222B | Local | Gravel | NA[1] |
| 223 | Local | Gravel | 5.81 |
| 224 | Local | Gravel | 0.72 |
| 225 | Local | Dirt | 4.05 |
| 225A | Local | Dirt | NA |
| 226 (Rustic Road) | Local | Gravel | 0.86 |
| 227 | Local | Gravel | 1.83 |
| 227A | Local | Dirt | NA |
| 227G | Local | Gravel | NA |
| 228 | Local | Gravel | 7.12 |
| 229 | Local | Gravel | 0.99 |
| 230 | Local | Gravel | 1.53 |
| 231 | Local | Gravel | 0.40 |
| 232 | Local | Gravel | 0.52 |
| 233 | Local | Asphalt | 0.97 |
| 234 | Minor Collector | Asphalt | 4.29 |
| 235 | Local | Gravel | 1.51 |
| 236 | Local | Gravel | 0.87 |
| 501 (Vallecito Road) | Minor Collector | Asphalt | 4.63 |
| 502 | Local | Gravel | 10.08 |
| 503 | Local | Gravel | 1.38 |
| 503A | Local | Gravel | NA |
| 503B | Local | Gravel | NA |
| 504 | Local | Gravel | 1.28 |
| 505 | Local | Gravel | 2.35 |
| 505A | Local | Gravel | NA |
| 506 | Local | Gravel | 0.44 |
| 507 | Local | Asphalt | 0.81 |
| 509 | Local | Asphalt | 0.82 |
| 509 | Local | Asphalt | 1.04 |
| 510 | Local | Gravel | 1.91 |
| 516 | Local | Asphalt | 0.88 |
| 521 (Buck Highway) | Major Collector Rural | Asphalt | 1.24 |
| 523 | Minor Collector Rural | Gravel | NA |
| 526 | Local | Gravel | 3.16 |
| 527 | Local | Gravel | 3.75 |
| 528 | Local | Dirt | 1.35 |
| Total | | | 79.53 |

Note:

1. NA = not described in Comprehensive Traffic Study

Source: La Plata County Planning Department 1999

All of the county roads in the Project Area are expected to experience substantial increases in traffic, reflecting a projected increase in population of nearly 56 percent in La Plata County between 1998 and 2020 (Colorado Department of Local Affairs 2001c). The largest increases in traffic are expected for County Roads 225, 229, 501, 502, and 509.

The traffic study projected future residential growth along highways and county roads for the 10 planning districts within La Plata County. The Project Area contains portions of three of these districts: Bayfield, Southeast La Plata, and Florida Mesa. The projected growth in the resident population and housing units along county roads in the Bayfield Planning District is 179 percent from 1998 through 2020. The projected growth along county roads in the Southeast La Plata District is 129 percent, and the growth projected for Florida Mesa is 31 percent. The projected population growth for La Plata County for this period is 56 percent.

The traffic study analyzed records for La Plata County to identify the number of accidents that occurred on county roads from January 1991 through August 1998. The data were used to isolate locations of multiple accidents and thus to identify segments of the county roads with safety issues. Accident rates are high on four county roads within the Project Area. County Road 501 includes four locations where the rate of accidents is high; one location is identified for each of the other road segments. These locations are summarized in Table 3–139. Records compiled by La Plata County indicate that the majority of accidents occur at intersections. According to the La Plata County Office of Emergency Management, an estimated six to 10 traffic incidents per year involve CBM-related vehicles. These vehicles are mostly water trucks used for dust control on access roads. No other data describe incidents that involve CBM-related vehicles in the Project Area.

**Table 3–139 Summary of Accident Locations and Recommended Improvements for La Plata County**

| County Road | High Accident Location | Number of Accidents at High Accident Location | Number of Accidents on Entire Road | Accident Rate[1] | Recommended Safety Improvements[2] |
|---|---|---|---|---|---|
| CR 228 | 0.4 mile E of CR 224 | 5 | 22 | 4.83 | None |
| CR 234 | 3.1 mile N of U.S. 160 | 6 | 26 | 2.41 | Roadway Realignment |
| CR 501 | -Intersection of U.S. 160 | 10 | 130 | 1.20 | None |
| | -0.1mile N of Sossaman Rd. | 4 | | 0.55 | Construct Auxiliary Lands and Bridge Replacement |
| | -Intersection of CR 502 | 5 | | 1.13 | Roadway Realignment |
| | -0.2 mile S of CR 500 | 7 | | 2.01 | None |
| CR 509 | Intersection of U.S. 160B | 6 | 20 | 2.39 | None |

Note:

1. The accident rate was calculated by dividing the number of accidents (per one million vehicles traveling past the significant accident locations) by the total number of vehicles (average daily traffic [ADT] multiplied by the survey duration of 2,770 days).
2. Safety improvements for road segments with high accident rates were identified in the La Plata County Comprehensive Traffic Study (La Plata County Planning Department 1999).

The traffic study identified three alternatives to mitigate large truck traffic. The first alternative recommends that companies responsible for truck traffic be required to construct improvements that are directly needed by the operation. Potential improvements include paving a gravel roadway and improving intersections and sight distances. The second alternative is a permitting process for trucks that drive on county roads. The permit would generate revenue that would address the impacts of trucks on county roads. A third alternative is increased effort to enforce existing regulations for overweight vehicles. The impacts of violations by overweight vehicles can be significant on low-volume county roads. No maintenance or compensation agreements currently have been reached between the companies and the county.

### 3.13.2.4 BLM Roads

Public land administered by the BLM is the smallest ownership type in the Project Area. BLM lands consist of isolated islands and tracts surrounded by private property. No BLM system roads are found within the Project Area. However, primitive roads or trails connect at least three parcels with county roads. An estimated 4.1 miles of access roads service CBM wells on BLM lands.

### 3.13.2.5 National Forest System Roads

Current management direction for NFSRs is to provide the minimum facilities and maintenance needed to safely accommodate the expected type and volume of traffic. Access routes on NFS lands in the Project Area include gravel and dirt roads and trails. The volume of traffic, type of surface, condition, and status of use for each numbered NFSR are summarized on Table 3–140. Conditions on NFS lands were verified in the field, as described in the Roads Analysis.

In addition to numbered NFSRs, un-numbered roads also cross NFS lands in the Project Area. These roads are primarily short, gravel-surfaced spurs used to access oil and gas wells, are in fair to good condition, and are open to all motor vehicles. An estimated 5.3 miles of roads serve CBM wells on NFS lands in the Project Area.

Access to NFSRs and NFS lands is gained via U.S. Highway 160, several primary county roads, and NFSRs. La Plata County Road 527 provides access to NFS lands directly from U.S. Highway 160. La Plata County Roads 523 and 525 provide access to Armstrong Canyon and Spring Creek. Sauls Creek (NFSR 608), Spring Creek (NFSR 537), and Fosset Gulch (NFSR 613) are the major NFSRs used to access the Project Area. These three improved light-duty gravel NFSRs connect with several smaller roads to form a network that provides access to most of the Project Area. NFSR 743 accesses a radio tower on the northeastern part of the Project Area and is paved. Many existing NFSRs provide access to existing oil and gas wells.

## Table 3–140 Conditions of Forest Service Road in the Project Area

| | | | | Open to[1]: | | | | |
|---|---|---|---|---|---|---|---|---|
| NFSR | ADT | Surface Type | Condition | Passenger Vehicles | ATVs/ Motorcycle | Admin Use | Oil & Gas | Notes |
| 123 | NA | Gravel/Dirt | Fair | P1 | Y1 | Y2 | Y3 | |
| 125 | NA | Primitive | Poor | N1 | Y1 | Y2 | N | |
| 126 | NA | Primitive | Poor | N1 | Y1 | Y2 | N | Inadequate maintenance |
| 127 | NA | Primitive | Poor | N1 | Y1 | Y | N | Inadequate maintenance |
| 131 | NA | Gravel | Good | P1 | Y1 | Y | Y | Inadequate maintenance |
| 131.A | NA | Gravel | Good | Y1 | Y1 | Y | Y | |
| 132 | NA | Gravel/Dirt | Good to poor | Y1 | Y1 | Y | Y | Gravel section is in good to fair condition, dirt section is in fair to poor condition. Blocked culvert. |
| 135 | NA | Gravel | Good | Y | Y | Y | Y3 | Closed road not properly signed and blocked. |
| 537 | 10-25 @ CR 335 | Gravel | Good to Fair | Y1 | Y1 | Y | Y | Lower portion in good condition, upper portion in fair condition. |
| 537.0 | NA | Dirt | Poor | Y1 | Y1 | Y | Y | |
| 537.A | NA | Dirt | Poor | Y1 | Y1 | Y | Y | |
| 607 | NA | Primitive | Poor | N | Y | Y2 | N | |
| 608 | 20-50 @ CR 527 | Gravel | Good | Y1 | Y1 | Y | Y | |
| 608.A | NA | Gravel | Good | P1 | Y1 | P | P | |
| 608.B | NA | Gravel | Fair | Y1 | Y1 | Y | Y | |
| 610 | NA | Primitive | Poor | N1 | Y1 | Y2 | N | Inadequate maintenance |
| 610.1 | NA | Primitive | Poor | N1 | Y1 | Y2 | N | Inadequate maintenance |
| 612 | NA | Gravel | Good | N | N | Y | N | |
| 613 | NA | Gravel | Good to fair | Y | Y | Y | Y | Partially blocked culvert. |
| 615 | NA | Gravel/ Primitive | Fair to poor | N1 | Y1 | Y | Y | Gravel section is in good to fair condition, primitive section is in fair to poor condition. |
| 615.A | NA | Gravel/Dirt | Fair to poor | Y1 | Y1 | Y | Y | Gravel section in fair condition. Dirt section in poor condition. |
| 743 | NA | Gravel | Good to fair | Y | Y | Y | Y3 | Two large slumps along fill slopes near tower. |
| 755 | NA | Gravel | Good | Y1 | Y1 | Y | Y | |
| 755.A | NA | Gravel | Good | Y1 | Y1 | Y | Y | |
| 756 | NA | Dirt | Fair to poor | Y1 | Y1 | Y | Y3 | |
| 841 | NA | Dirt | Fair to poor | N | Y | Y | Y3 | Stream crossing improvements needed |
| 841.B | NA | Dirt | Fair to poor | N | Y | Y | Y3 | |
| 841.C | NA | Dirt | Fair to poor | N | Y | Y | Y3 | |
| 841.E | NA | Dirt | Fair to poor | N | Y | Y | Y3 | |
| 842 | NA | Dirt | Fair | Y | Y | Y | Y | |
| 924 | NA | Dirt | Fair | Y | Y | Y | Y3 | |

Note:

1. Y = Open, N = Closed, P = Partially open. 1 = Seasonal closure to protect wintering big game, 2 = Open to administrative use, but accessible by ATVs and motorcycles only, and 3 = Open to oil and gas use, but not used for this purpose.

Source: FS 2003b

Access to NFSRs and NFS lands is gained via U.S. Highway 160, several primary county roads, and NFSRs. La Plata County Road 527 provides access to NFS lands directly from U.S. Highway 160. La Plata County Roads 523 and 525 provide access to Armstrong Canyon and Spring Creek. Sauls Creek (NFSR 608), Spring Creek (NFSR 537), and Fosset Gulch (NFSR 613) are the major NFSRs used to access the Project Area. These three improved light-duty gravel NFSRs connect with several smaller roads to form a network that provides access to most of the Project Area. NFSR 743 accesses a radio tower on the northeastern part of the Project Area and is paved. Many existing NFSRs provide access to existing oil and gas wells.

As noted on Table 3–140, many NFSRs are closed periodically for various reasons. In general, NFSRs in the Project Area are completely or partially closed during the winter because the FS does not plow snow. Additionally, roads to Lange Canyon (NFSR 132), Sauls Creek, Turkey Creek (NFSR 615), and Spring Creek are closed seasonally to protect wildlife.

The Forest Standards and Guidelines (FS 1983) specify densities for open local roads for each of the five management areas within the Project Area. The existing density of roads for Management Area 6B exceeds the standards in the LRMP, as shown on Table 3–141. FS classified open roads in the remaining Management Areas meet the forest standards.

**Table 3–141 Road Density for Management Areas in the Analysis Area**

| | Road Density (miles of road per square mile) | | Forest Plan Standard (miles of road per square mile) |
|---|---|---|---|
| Management Area | FS Classified Open | FS Classified Closed/Unclassified | Local open roads |
| 2B | 0.39 | 0.14 | 0.5 to 1.0 |
| 3A | 0.83 | 0.96 | No standard |
| 4B | 0.19 | 0.15 | 0.5 to 1.0 |
| 5B | 0.34 | 0.23 | 0.0 to 0.5 |
| 6B | 1.36 | 0.91 | 0.5 to 1.0 |
| Total | 3.11 | 1.08 | |

Source: FS 1982

The existing road system adequately reflects the need to connect public roads and provide access to the Project Area. The road system (primarily NFSR 121) provides adequate access to cabins and other improvements on private lands in the Project Area. State Highway 65 crosses the Project Area and is connected to several NFSRs that provide the primary access to adjacent public lands. Each part of the existing road system has been built to safely accommodate the anticipated uses. However, there may be outstanding safety issues based on the high level of use on several of these roads (for example, on NFSRs 121 and 123).

### 3.13.2.6 Oil and Gas Industry Traffic

CBM traffic has traveled on county roads in La Plata and Archuleta Counties since the mid-1980s. In fact, the first CBM production in the area occurred in 1951 on the nearby Southern Ute Indian Reservation. However, little development occurred in the SJB until 1980, when the Crude Oil Windfall Profits Tax Act was enacted and industry improved the technical capability for CBM production.

CBM has been the focus of natural gas development in the SJB since 1988. Despite this history of development, no complaints have been lodged against the industry that have identified damage to county roads from CBM vehicles. However, heavy trucks cause more damage to road surfaces of all types than do automobiles and light trucks.

Traffic related to development of oil and gas in the Project Area consists of vehicle trips associated with installation of wells, compressors, and pipelines, and with maintenance of the facilities. Table 3–142 summarizes the number of annual and daily vehicle trips typically attributed to CBM and non-CBM traffic in the NSJB.

**Table 3–142 Baseline Trip Generation by CBM Wells**

| Parameter | Active CBM | Active non-CBM | Total |
|---|---|---|---|
| Number of Wells | 276 | 34 | 310 |
| Annual Trips | 102,396 | 12,614 | 115,010 |
| Daily Vehicle Trips | 35 | 4 | 39 |

Source: BLM et al. 2002

Maintenance occurs over the life of the facilities and consists of well workovers and other operations. The analysis assumed that active production wells and disposal or injection wells would continue to require daily maintenance trips that total 365 per year and an annual workover (six trips per workover). Thus, 371 trips per CBM and non-CBM well would be required annually for maintenance, on average (Table 3–142).

Daily service trips must be factored by the average number of well sites each service crew can visit in 1 day to compute daily vehicle trips for all wells in the Project Area. It was assumed for this analysis that one service crew can visit eight wells per day. Daily vehicle trips therefore equal the number of annual service trips divided by 365 days per year divided by 8 wells per service crew. Thus, personnel for all companies combined would make 39 daily service trips (Table 3–142).

Six compressors currently serve the Project Area. Table 3–143 summarizes baseline number of annual compressor maintenance trips. Each compressor site currently requires daily maintenance trips, for a total of 365 per year (pickup and crew cab visits), and an annual workover (one site per visit per multi-axle vehicle). This analysis assumed that each service crew can visit four sites per vehicle per day. Daily vehicle trips average 1.5 vehicles per day, which is less than 1 percent of total average daily traffic on all state highways or county roads within the Project Area.

**Table 3–143 Compressor Maintenance Vehicle Trip Generation – Baseline**

| Number of Compressors | Average Number of Trips Generated | Annual Service Trips per Unit | Annual Trips | Daily Vehicle Trips[1] |
|---|---|---|---|---|
| 6 | 7 to 14 crew cab/pickup visits per week | 546 | 3,276 | 1.5 |
| 6 | 1 multi-axle visit per year | 1 | 6 | <1 |
| Total Compressor Maintenance Trips Generated | | | 2,188 | 1.5 |

Note:
1. One daily vehicle trip = annual trips/365/4 sites per vehicle per day.
Source: BLM et al. 2002

The agencies recognize that some smaller compressors are collocated with wells at some sites and that both facilities may be maintained in a single trip to the site. However, both facilities are not always maintained with a single trip. Consequently, the analysis conservatively treated these compressors as stand-alone facilities in counting vehicle trips.

Estimates of the current number of vehicle trips for maintenance of compressors and wells associated with each segment of county road were developed based on the methodology in the La Plata County Comprehensive Traffic Study to project population and housing growth in the county. Section 3.1.5 of that study summarizes the methodology, which is based on road segments and associated land parcels. Each county land parcel was assigned to a road segment primarily based on locations and connectivity of minor roads, topography, and local knowledge. The road segments identified in the process were used to estimate existing CBM vehicle traffic. The traffic related to CBM was linked to road segments and roads were rated as low, medium, and high to indicate the level of impact from additional CBM traffic on roads in the Project Area.

## 3.13.3 Environmental Consequences

The analysis of transportation impacts addresses the effects from seven alternative development scenarios on the network of roads in the Project Area. Anticipated CBM development would result in an increase in CBM gas industry traffic. CBM-related traffic travels between well sites and staging areas on highways and county roads and may affect local traffic patterns, create safety problems, and damage roads. The majority of CBM traffic would travel on roads that are under the jurisdiction of La Plata County and the San Juan National Forest. County roads in the Project Area are generally designed for light-duty traffic and connect residential subdivisions and rural tracts with U.S. Highway 160, Durango, and Bayfield.

### 3.13.3.1 Alternative 1 — Proposed Action

Three types of impacts are of concern: (1) additional traffic on county roads and existing roadway congestion; (2) the number of traffic accidents in the Project

Area; and (3) conflicts with public access to existing residential uses from CBM traffic on county roads, as well as from construction and operation of well access roads.

CBM-related traffic consists of construction vehicles that would build access roads and well pads and vehicles that haul components of the drill rig, other equipment, and supplies. Typical vehicles include a tractor dozer, tractor/ backhoe, road grader, gravel trucks, and light trucks used to transport employees. It is anticipated that CBM construction would proceed at a rate that requires four drill rigs operating on an annual basis, limited to seasonal restrictions. An average of two round trips per construction of each segment of road would be required for the trucks that haul the dozers, graders, and backhoes. An average of three round trips per day by management and worker vehicles (pickups) would occur for the duration of road construction. Six to 12 days likely would be required to drill each target well.

Traffic levels and impacts that result from long-term CBM production operations would consist of daily light truck travel by employees involved in operations, metering, and maintenance of production wells, flowlines, and compression facilities. Maintenance would occur daily during each year over the life of the CBM production anticipated, with an additional 6 trips over 1 to 2 days for an annual workover.

#### *3.13.3.1.1 Federal Highway Network*

U.S. Highway 160 is the only federal highway that would be used by CBM-related traffic in the immediate Project Area. The daily volume of traffic on most segments of U.S. Highway 160 is expected to increase substantially between 1998 and 2020, as shown on Table 3–144. The number of vehicle trips proposed for CBM facilities that would use the highway as the primary route to reach access roads to wells is small relative to existing traffic in 1998 and to projected daily background traffic in 2020. Assuming development occurs over 5 years, there would be no discernible impact to daily traffic from CBM vehicle trips.

Several roadway projects have been identified in the Southwest Colorado 2020 Transportation Plan. This analysis projects level of service (LOS) only to 2020 because comparative data for this area have not been developed beyond 2020. None of the projects identified in the plan includes widening or other improvements that would increase the capacity on U.S. Highway 160. It is likely that the projected LOS classes for 2016 would apply to traffic conditions projected for 2020.

Any potential increase in the rate of accidents from CBM vehicles would occur over the life of anticipated CBM production. Construction traffic includes vehicles that range in size and weight from light to heavy trucks. Maintenance traffic, however, generally consists of light trucks. As shown on Table 3–145, the increase in daily traffic levels projected from anticipated CBM-related traffic is small. There would be no perceptible effect on the overall rate of accidents on highways because the volume of traffic from anticipated CBM development on most of these roads is projected to be less than 1-percent.

### Table 3–144 Summary of Average Daily Traffic Count for Existing Daily Trips for CBM Wells and Compressors for Selected La Plata County Roads

| | | ADT for All Vehicle Types | | Daily Trips for Existing CBM Wells[1] | |
|---|---|---|---|---|---|
| Route Name[2] | Location | 1998 ADT | Projected 2020 ADT | Average Daily Trips (incl. in ADT for all vehicles) | Percent Included in 1998/2020 ADT |
| CR 220 | 2.3 Mile W of SH 172 | 1,817 | 3,579 | 2 | <1.0/<1.0 |
| CR 220 | 0.67 Mile W of SH 172 | 1,378 | 2,715 | 3 | <1.0/<1.0 |
| CR 223 | 1 Mile E. of CR 225 | 245 | 385 | 27 | 2.9/1.8 |
| CR 225 | 0.67 Mile N. of CR 223 | 574 | 1,366 | 1 | <1.0/<1.0 |
| CR 225 | 2.81 Mile N. of CR 223 | 427 | 1,017 | 2 | <1.0/<1.0 |
| CR 228 | 0.31 Mile E. of CR 234 | 289 | 690 | 2 | <1.0/<1.0 |
| CR 228 | 2.02 Mile E. or CR 225 | 374 | 895 | 3 | <1.0/<1.0 |
| CR 229 | 0.26 Mile N. of U.S. 160 | 562 | 1,404 | 1 | <1.0/<1.0 |
| CR 233 | 0.53 Mile N. of U.S. 160 | 330 | 491 | 2 | <1.0/<1.0 |
| CR 234 | 2.1 Mile N. of U.S. 160 | 898 | 1,401 | 1 | <1.0/<1.0 |
| CR 234 | 0.5 Mile N. of U.S. 160 | 1,249 | 1,948 | 0 | 0 |
| CR 501 | 4.2 Mile N. of U.S. 160 | 2,182 | 5,346 | 16 | <1.0/<1.0 |
| CR 502 | 0.77 Mile N. of U.S. 160 | 707 | 1,950 | 2 | <1.0/<1.0 |
| CR 502 | 3.4 Mile N. of U.S. 160 | 342 | 945 | 7 | 2.0/<1.0 |
| CR 509 | 0.56 Mile S. of U.S. 160 | 907 | 2,784 | 1 | <1.0/<1.0 |
| CR 510 | 0.52 Mile E. of CR 222 | 883 | 1,854 | 2 | <1.0/<1.0 |

Notes:

1. Each well requires a daily maintenance trip and an annual workover (6 trips per workover) for a total 371 trips per year per well, or 1.02 daily trips per well. The total daily trips per well have been rounded to the nearest whole number in the table.
2. Road segments from the La Plata County Comprehensive Traffic Study correspond to road segments presented in this table to compare traffic volumes.

Source: La Plata County Planning Department 1999

### Table 3–145 Highway Traffic Volume and LOS – Alternative 1

| Highway (segment) US Highway 160 | 1998 Daily Volume | 1998 LOS | Projected 2020 Daily Background Volume | Projected 2020 LOS | Proposed Daily CBM Vehicle Trips | Percent Increase in Daily Background Volume from CBM Trips |
|---|---|---|---|---|---|---|
| US Highway 160 - SH3 to Bayfield Bus. Loop | 10,432 | E | 17,507 | F | 16 | <1 |
| US Highway 160 Business Loop | 1,979 | E | 2,703 | F | 3 | <1 |
| US Highway 160 - CR501 E. to county line | 4,134 | E | 4,021 | F | 8 | <1 |

Notes:

LOS E – operating conditions near or at capacity

LOS F – forced or breakdown flow conditions

Source: Southwest Region Transportation Planning Commission 1999

The locations along U.S. Highway 160 where conflicts between CBM vehicles and other highway traffic are most likely to occur are at intersections where CBM vehicles turn onto highways from access roads.

Most of the freight that moves through the Project Area is hauled in heavy trucks, which has resulted in concerns about deterioration of road surfaces. Heavy trucks are responsible for a disproportionate amount of pavement damage on highways. Heavy trucks would account for about 25 percent of proposed CBM construction vehicle traffic on U.S. Highway 160. However, daily construction trips by heavy vehicles would be spread out over the 5-year construction period. Each of the 296 proposed wells would require about six trips made by heavy construction vehicles over the construction period of 2 weeks per well. The number of wells that would be drilled within the Project Area would vary over the 5-year construction period; however, an average of one to two wells would be installed every week during the construction period. Therefore, heavy construction vehicles would make an estimated total six to 12 trips over each 2-week period within the Project Area. The number of heavy construction vehicles would be considerably less than 1-percent on any segment of U.S. Highway 160 within the Project Area.

According to the Transportation System Inventory (Southwest Region Transportation Planning Commission 1999), surface conditions on U.S. Highway 160 range from poor to fair. Current conditions indicate that highway maintenance practices have not kept pace with increased traffic levels that have resulted from the growing population of La Plata and Archuleta Counties. The Southwest Regional Transportation District has identified several improvement projects for the highway within the Project Area. U.S. Highway 160 is a freight route, with approximately 7 to 14 percent truck traffic on highway segments in the Project Area. It is not anticipated that CBM traffic would result in significant degradation of the road surface. The number of heavy construction vehicles would be considerably less than 1 percent on any segment of U.S. Highway 160 within the Project Area.

#### 3.13.3.1.2 County Transportation Network

The volume of traffic on county roads that would result from anticipated CBM development in the Project Area was estimated from the methods to generate trips to wells and compressors that are presented in Section 3.13.2.6. This methodology and the following significance criteria have been used for the analysis of impacts to transportation for other oil and gas developments in southwest Colorado. These criteria indicate whether an impact, a significant impact, or no perceivable impact would occur.

An impact would occur if CBM development were projected to generate 10 percent or more additional daily vehicle trips over the number that is expected to occur without further development of oil and gas in the Project Area. These criteria were developed in the BLM's FEIS for Oil and Gas Development on the Southern Ute Indian Reservation (2002). A significant impact on the volume of traffic would exist if anticipated CBM development were projected to generate 25 percent or more additional daily vehicle trips. Traffic from CBM development would have no perceivable impact if it generates less than 10 percent of additional vehicle daily trips. Table 3–146 summarizes daily trips associated with existing and anticipated CBM wells in the Project Area, and compares the trips with the average daily traffic (ADT) volume of all vehicle types for 1998 and the projected ADT in 2020 for selected roads in La Plata County. The table shows that increases generated by CBM maintenance traffic are less than 10 percent of additional average daily trips on the selected segments of county roads and therefore would have no perceivable impact.

The maximum maintenance traffic from CBM development that would be added to existing traffic on roads in the Project Area from all vehicle types is less than 1 percent of the total daily levels for most affected county roads. There is, therefore, no significant impact on the volume of traffic because projected CBM-related vehicles would not generate 25 percent or more additional daily vehicle trips on any county roads in the Project Area. The projected CBM-related vehicles would generate less than 10 percent of additional daily vehicle trips on every affected county road; therefore, there would be no perceptible impact to the volume of traffic on county roads in the Project Area.

Traffic levels and impacts that would result from construction-related activities are expected to be short term, lasting from a few days to a few months in any specific area. Traffic on roads that would be crossed by any flowlines would experience minor delays caused by lane closures during construction. The remaining lanes would be capable of handling the expected traffic.

The largest increases from CBM-related traffic would occur on CR 223, averaging 27 daily vehicle trips for each year from the current year through 2020. The maximum projected ADT for all vehicles is 385 in 2020. The total daily traffic of about 412 vehicles in 2020 is within the maximum design capacity of 999 for CR 223. CR 225 and CR 501 are the other county roads that would experience increases that exceed 1 percent in daily traffic from additional CBM maintenance vehicles. These increases slightly exceed 1 percent of the ADT for the base year of 1998.

Records compiled by La Plata County indicate that the majority of accidents occur at intersections. There is a potential for increased accident rates from traffic conflicts with vehicles that are involved in construction of access roads and well pads. These construction vehicles also would be involved in well drilling, completion, and installation, which would occur over the construction period of 6 to 12 days per well. The disparity in size and weight between passenger vehicles (automobiles and light trucks) and the medium to heavy trucks required for construction of CBM facilities could result in an increase in accidents that are fatal or cause serious injury.

Four county roads in the Project Area include segments where the rate of accidents is high: CR 228, CR 234, CR 501, and CR 509. These roads provide access to residential subdivisions within and north and south of the Project Area. As shown on Table 3–146, the increase in daily traffic levels projected from anticipated CBM-related maintenance traffic is small between 2003 and 2020. Impacts beyond 2020 are expected to be similar in magnitude and intensity. There would be no perceptible effect on the overall rate of accidents rates on county roads because the volume of traffic from anticipated CBM development on most of these roads is projected to be less than 1 percent.

## Table 3–146 Summary of Average Daily Traffic Count, Existing and Anticipated Daily Trips for CBM Wells and Compressors for Selected La Plata County Roads in the Project Area

| | | ADT for All Vehicle Types | | Daily Trips for Existing CBM Wells[1] | | Daily Trips for Anticipated CBM Facilities[1] | | Cumulative Daily Trips | |
|---|---|---|---|---|---|---|---|---|---|
| Route Name[2] | Location | 1998 ADT | Projected 2020 ADT | Average Daily Trips (incl. in ADT for all vehicles) | Percent included in 1998/2020 ADT | Average Daily Trips | Percent Increase in 1998/2020 ADT | Average Daily Trips | Percent Increase in 1998/2020 ADT |
| CR 220 | 2.3 Mile W of SH 172 | 1,817 | 3,579 | 2 | <1.0/<1.0 | 1 | <1.0/<1.0 | 3 | <1.0/<1.0 |
| CR 220 | 0.67 Mile W of SH 172 | 1,378 | 2,715 | 3 | <1.0/<1.0 | 0 | 0 | 3 | <1.0/<1.0 |
| CR 223 | 1 Mile E. of CR 225 | 245 | 385 | 27 | 2.9/1.8 | 13 | 5.3/3.4 | 40 | 16.3/10.4 |
| CR 225 | 0.67 Mile N. of CR 223 | 574 | 1,366 | 1 | <1.0/<1.0 | 0 | 0 | 1 | <1.0/<1.0 |
| CR 225 | 2.81 Mile N. of CR 223 | 427 | 1,017 | 2 | <1.0/<1.0 | 2 | <1.0/<1.0 | 4 | <1.0/<1.0 |
| CR 228 | 0.31 Mile E. of CR 234 | 289 | 690 | 2 | <1.0/<1.0 | 3 | 1.0/<1.0 | 5 | 1.7/<1.0 |
| CR 228 | 2.02 Mile E. or CR 225 | 374 | 895 | 3 | <1.0/<1.0 | 5 | <1.0/<1.0 | 8 | 2.1/<1.0 |
| CR 229 | 0.26 Mile N. of US Highway 160 | 562 | 1,404 | 1 | <1.0/<1.0 | 0 | 0 | 1 | <1.0/<1.0 |
| CR 233 | 0.53 Mile N. of US Highway 160 | 330 | 491 | 2 | <1.0/<1.0 | 0 | 0 | 2 | <1.0/<1.0 |
| CR 234 | 2.1 Mile N. of US Highway 160 | 898 | 1,401 | 1 | <1.0/<1.0 | 0 | <1.0/<1.0 | 1 | <1.0/<1.0 |
| CR 234 | 0.5 Mile N. of US Highway 160 | 1,249 | 1,948 | 0 | 0 | 0 | <1.0/<1.0 | 0 | <1.0/<1.0 |
| CR 501 | 4.2 Mile N. of US Highway 160 | 2,182 | 5,346 | 16 | <1.0/<1.0 | 9 | <1.0/<1.0 | 25 | 1.1/<1.0 |
| CR 502 | 0.77 Mile N. of US Highway 160 | 707 | 1,950 | 2 | <1.0/<1.0 | 0 | 0 | 2 | <1.0/<1.0 |
| CR 502 | 3.4 Mile N. of US Highway 160 | 342 | 945 | 7 | 2.0/<1.0 | 1 | <1.0/<1.0 | 8 | <1.0/<1.0 |
| CR 509 | 0.56 Mile S. of US Highway 160 | 907 | 2,784 | 1 | <1.0/<1.0 | 0 | 0 | 1 | <1.0/<1.0 |
| CR 510 | 0.52 Mile E. of CR 222 | 883 | 1,854 | 2 | <1.0/<1.0 | 1 | <1.0/<1.0 | 3 | <1.0/<1.0 |

Notes:

1 Each well requires a daily maintenance trip and an annual workover (6 trips per workover) for a total 371 trips per year per well, or 1.02 daily trips per well. The total daily trips per well have been rounded to the nearest whole number in the table.

2 CR = County road, SH = State highway

Source: La Plata County Planning Department 1999c

#### 3.13.3.1.3 CBM Traffic Conflicts with Land Uses

Anticipated CBM development in the Project Area is located in an area of ongoing growth of residential uses on private lands (see the section on Land Use). The primary county roads used for residential access include CRs 223, 228, 501, 502, 504, and 505. Future residential growth is likely to occur along these same corridors.

The greatest increases in volume from projected CBM construction and maintenance traffic would occur on segments of CRs 223, 228, 501, 502, 504, 505, and 527. With the exception of CR 527, these roads are the same that are used to access existing and future residential development. The potential for conflicts with CBM-related traffic is highest along these roads. Two of these roads (CRs 228 and 501) were identified as locations of high rates of accidents.

Table 3–147 estimates, by vehicle weight, the number of trips required for construction and installation of wells on selected La Plata County roads. The table shows the proportionate impact that is anticipated by vehicles in various weight classes. The estimate of daily trips by construction vehicles on each road assumed that all construction and installation would require 2 weeks per well. The estimate further assumed that construction would be spread out over 5 years. The number of trips estimated for each road segment that would bear traffic from more than one well would not necessarily occur either simultaneously or consecutively, but may occur during any 2-week period over the 5-year construction phase.

Conflicts between CBM and local residential traffic in the Project Area would be most likely to occur during the 2-week construction period for each well, as heavy trucks hauling supplies and equipment would use county roads that also access residential areas. It is anticipated that any increases in traffic levels at any one time on county roads would fall within the capacity of the roads; however, the potential for incidents would increase at intersections where project-related traffic turns onto county roads.

In addition, residents and recreationists near proposed CBM facilities would be affected by the sight and sound of vehicles delivering material and supplies to each well site, and by construction vehicles engaged in well drilling and construction. Residential areas in the Project Area are located on private lands in La Plata County. Residential uses consist of dispersed uses on NFS lands, trail systems on NFS and BLM lands, and private campgrounds.

#### 3.13.3.1.4 Road Maintenance

CBM-related traffic would increase the percentage of heavy trucks on county roads to a greater degree than is indicated by the small increases in overall volume of traffic. The daily traffic trips for all vehicle weight classes, as shown on Table 3–147, is a worst-case scenario that assumes that all wells associated with each road segment would be drilled within the same 2-week period.

## Table 3–147 Projected Alternative 1 CBM Vehicle Trips for Construction Activities by Road Segment

| Road Segments | Number of Proposed Wells | Trip Frequency for Light Vehicles[1] | ADT for Light Vehicles | Trip Frequency for Medium Vehicles[1] | ADT for Medium Vehicles | Trip Frequency for Medium Heavy Vehicles[1] | ADT for Medium Heavy Vehicles | Trip Frequency for Heavy Vehicles[1] | ADT for Heavy Vehicles |
|---|---|---|---|---|---|---|---|---|---|
| CR 213 - U.S.550/160 south to CR214 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 220 – CR 301 east to SR172 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 220 - U.S.550 east to CR301 | 1 | 100 | 7 | 67 | 5 | 88 | 6 | 87 | 6 |
| CR 221 – CR 222 east to end | 1 | 100 | 7 | 67 | 5 | 88 | 6 | 87 | 6 |
| CR 221 – SR 172 east to CR 222 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 222 – CR 510 south to SR172 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 222 - U.S.160 south to CR510 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 223 – CR 225 east to U.S.160 | 13 | 1,300 | 93 | 871 | 62 | 1,144 | 82 | 1,131 | 81 |
| CR 223 - U.S.160 north to CR 230 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 224 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 225 – CR 223 north to CR226 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 225 – CR 226 north to CR228 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 225 – CR 228 north to CR234 | 2 | 200 | 14 | 134 | 10 | 176 | 13 | 174 | 12 |
| CR 226 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 227 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 228 – CR 224 east to CR502 | 5 | 500 | 36 | 335 | 24 | 440 | 31 | 435 | 31 |
| CR 228 – CR 225 east to CR224 | 3 | 300 | 21 | 201 | 14 | 264 | 19 | 261 | 19 |

## Table 3–147 Projected Alternative 1 CBM Vehicle Trips for Construction Activities by Road Segment

| Road Segments | Number of Proposed Wells | Trip Frequency for Light Vehicles[1] | ADT for Light Vehicles | Trip Frequency for Medium Vehicles[1] | ADT for Medium Vehicles | Trip Frequency for Medium Heavy Vehicles[1] | ADT for Medium Heavy Vehicles | Trip Frequency for Heavy Vehicles[1] | ADT for Heavy Vehicles |
|---|---|---|---|---|---|---|---|---|---|
| CR 228 – CR 229 north to CR225 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 228 – CR 234 east to CR229 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 229 – CR 230 north to CR228 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 229 - U.S.160 north to CR 230 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 230 | 1 | 100 | 7 | 67 | 5 | 88 | 6 | 87 | 6 |
| CR 232 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 233 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 234 – CR 225 north to CR237 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 234 – CR 228 north to CR235 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 234 – CR 235 north to CR236 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 234 – CR 236 north to CR225 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 234 – CR 237 north to CR240 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 235 | 1 | 100 | 7 | 67 | 5 | 88 | 6 | 87 | 6 |
| CR 236 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 501 - U.S.160 north to Forest Lakes | 8 | 800 | 57 | 536 | 38 | 704 | 50 | 696 | 50 |
| CR 502 – CR 228 east to CR 503 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 502 – CR 245 west to CR 228 | 4 | 400 | 29 | 268 | 19 | 352 | 25 | 348 | 25 |
| CR 502 – CR 503 east to CR 504 | 2 | 200 | 14 | 134 | 10 | 176 | 13 | 174 | 12 |

## Table 3–147 Projected Alternative 1 CBM Vehicle Trips for Construction Activities by Road Segment

| Road Segments | Number of Proposed Wells | Trip Frequency for Light Vehicles[1] | ADT for Light Vehicles | Trip Frequency for Medium Vehicles[1] | ADT for Medium Vehicles | Trip Frequency for Medium Heavy Vehicles[1] | ADT for Medium Heavy Vehicles | Trip Frequency for Heavy Vehicles[1] | ADT for Heavy Vehicles |
|---|---|---|---|---|---|---|---|---|---|
| CR 502 – CR 504 east to CR 505 | 2 | 200 | 14 | 134 | 10 | 176 | 13 | 174 | 12 |
| CR 502 – CR 505 south to U.S.160 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 503 | 1 | 100 | 7 | 67 | 5 | 88 | 6 | 87 | 6 |
| CR 504 | 7 | 700 | 50 | 469 | 34 | 616 | 44 | 609 | 44 |
| CR 505 | 4 | 400 | 29 | 268 | 19 | 352 | 25 | 348 | 25 |
| CR 506 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 507 | 1 | 100 | 7 | 67 | 5 | 88 | 6 | 87 | 6 |
| CR 508 | 3 | 300 | 21 | 201 | 14 | 264 | 19 | 261 | 19 |
| CR 509 - U.S.160B south to CR 510 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 510 – CR 222 east to CR 513 | 1 | 100 | 7 | 67 | 5 | 88 | 6 | 87 | 6 |
| CR 516 - U.S.160B south to CR 520 | 1 | 100 | 7 | 67 | 5 | 88 | 6 | 87 | 6 |
| CR 525 – CR 523 east to end | 4 | 400 | 29 | 268 | 19 | 352 | 25 | 348 | 25 |
| CR 526 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 527 – CR 526 east to CR 528 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 527 – CR 528 north to end | 33 | 3,300 | 236 | 2,211 | 158 | 2,904 | 207 | 2,871 | 205 |
| CR 528 | 3 | 300 | 21 | 201 | 14 | 264 | 19 | 261 | 19 |
| SR 172 Corridor - U.S.160 south to CR 309 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SR 3 Corridor | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| U.S. Highway 160 B Corridor - U.S.160 east to U.S.160 | 3 | 300 | 21 | 201 | 14 | 264 | 19 | 261 | 19 |

## Table 3–147 Projected Alternative 1 CBM Vehicle Trips for Construction Activities by Road Segment

| Road Segments | Number of Proposed Wells | Trip Frequency for Light Vehicles[1] | ADT for Light Vehicles | Trip Frequency for Medium Vehicles[1] | ADT for Medium Vehicles | Trip Frequency for Medium Heavy Vehicles[1] | ADT for Medium Heavy Vehicles | Trip Frequency for Heavy Vehicles[1] | ADT for Heavy Vehicles |
|---|---|---|---|---|---|---|---|---|---|
| U.S. Highway 160 Corridor – CR 223 (west end) east to CR 223 (east end) | 4 | 400 | 29 | 268 | 19 | 352 | 25 | 348 | 25 |
| U.S. Highway 160 Corridor – CR 223 east to CR 501 | 6 | 600 | 43 | 402 | 29 | 528 | 38 | 522 | 37 |
| U.S. Highway 160 Corridor – CR 501 east to Archuleta County line | 7 | 700 | 50 | 469 | 34 | 616 | 44 | 609 | 44 |
| U.S. Highway 160 Corridor – SR 172 east to CR 223 | 2 | 200 | 14 | 134 | 10 | 176 | 13 | 174 | 12 |
| U.S. Highway 160 Corridor - U.S.550 east to SR 172 | 4 | 400 | 29 | 268 | 19 | 352 | 25 | 348 | 25 |
| U.S. 550/160 Corridor - CR 203 south to Farmington Hill | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NOT IN LINK AREA | 169 | 16,900 | 1,207 | 11,323 | 809 | 14,872 | 1,062 | 14,703 | 1,050 |
| Total | 296 | 29,600 |  | 19,832 |  | 26,048 |  | 25,752 |  |

Notes:

1. Typical Vehicle Weights (lbs) — Light: <6,000 and 6001 to 10,000, Medium: 10,001 to 14,000 and 14,001 to 16,000, Medium heavy: 16,001 to 19,600 and 19,601 to 26,000, Heavy: 26,001 to 33,000 and 33,001 and over

Light trucks account for about 29 percent of the total number of trips by CBM construction vehicles. The costs for road maintenance from light trucks are the same as from deterioration caused by other passenger vehicles. The total vehicle trips by 31,800 light trucks would be spread out over an estimated 5-year construction period for all wells proposed for the Project Area. Light-truck traffic associated with each well would be temporary, occurring over an estimated construction and installation period of 2 weeks.

Heavy truck traffic would account for about 25 percent of the total number of trips by CBM construction vehicles. Heavy truck traffic would result in increased costs for road maintenance because they cause more damage to road surfaces of all types than do automobiles and light trucks. The County Road and Bridge Department indicates that maintenance costs on roads with CBM traffic by heavy trucks have increased because the impact from one combination truck (a truck with three axles or more) is the same as from 1,350 passenger cars. It is anticipated that county road maintenance cost would increase from construction-related truck traffic.

The existing average daily trips for all types of vehicles on selected county roads total 72 (see Table 3–146). The proposed alternative would increase the CBM traffic on these roads approximately 49 percent, to 102 average daily trips. Because 25 percent of the vehicle trips would be heavy trucks, there would be approximately 26 heavy trucks added to the existing average daily traffic from CBM vehicles. The increase in heavy truck traffic would accelerate deterioration of pavement, requiring the county to schedule pavement repair or replacement more frequently than under existing traffic conditions. The 1997 Federal Highway Cost Allocation Study estimates that the cost per mile for an 80,000-pound combination truck on rural highways is 18.1 cents per mile, which is significantly higher than the 0.1 cents per mile damage caused by passenger vehicles on rural highways.

Some heavy trucks or loads they carry may exceed allowable weight limits for bridges on county roads. These vehicles would require a special permit from the county. The conditional special permit is valid for one-way trips for loads that exceed the maximum limits indicated on the bridge weight limit map, which is on file in the county clerk and recorder's office. Overweight vehicles may also require a transport permit to move or operate on a roadway.

Fees paid to the county from permits contribute to county revenues. Currently, about 32 percent of revenues are spent on roads and bridges, including road maintenance.

Medium- to medium-heavy trucks account for the remaining 46 percent of the total number of CBM construction vehicle trips. The total vehicle trips by medium- to medium-heavy trucks would be spread out over an estimated 5-year construction period. Traffic by medium- to medium-heavy trucks associated with each well would be temporary and would occur over an estimated construction and installation period of 2 weeks.

The La Plata County Code (Chapter 1, General Provisions, Subpart B, Land Use System) includes standards for surface disturbance for oil and gas facilities located on lands within the unincorporated area of the county, with the exception of areas under federal or state jurisdiction. Installation of facilities that are accessible by unmaintained roads included in the county system is permitted only if they are improved. In addition, they must be maintained by the applicant to a level the county engineer deems necessary to allow the traffic to use these roads in accordance with applicable state and county standards.

#### *3.13.3.1.5 BLM Roads*

It is anticipated that 3 miles of access road would be constructed on BLM parcels within the Project Area. The rights of way for the access roads would be 40 feet. Assuming that the entire right of way would be disturbed during road construction, approximately 14.5 acres would be disturbed on BLM parcels. No existing roads accommodate vehicles on the affected parcels. There would be no conflict with other traffic on BLM lands.

The La Plata County road network would be used to access CBM facilities and associated roads on BLM land. The potential for traffic conflicts would occur at intersections of BLM access roads with county roads.

There is potential for new roads to provide access for dirt bikes, four-wheelers, ATVs, and snowmobiles in previously roadless areas on BLM lands. BLM lands are accessible only via public roads or across private land, which requires permission of the landowner. BLM lands in the Project Area are isolated parcels surrounded by private lands and are not large enough to provide a satisfying recreational experience for motorized and nonmotorized users of the roads and trails.

#### *3.13.3.1.6 National Forest System Roads*

The locations of the proposed roads for each alternative were estimated for the roads analysis on NFS lands based on proposed well locations, topography, the existing road system, and professional judgment. In most cases, locations for proposed roads are identified because well locations also were identified. Roads were not geographically assumed or mapped where only drilling windows are identified; however, it was assumed that each well would result in one-half mile of new road construction to estimate the total disturbance from unmapped roads in this area. The location of roads that would access drilling windows was not known.

An on-site visit will be conducted with agency personnel during the APD stage of the proposed project, and the location of the road will be identified using survey and engineering techniques, as appropriate. This roads analysis assumed that all compressor stations and injection wells would be accessed via an existing or proposed CBM road. The locations assumed in this analysis represent the best available information on the proposed road system. As development occurs, this analysis may be updated to reflect changes in the proposed system of roads.

The proposed road system for the NSJB CBM Project is discussed in detail in Chapter 2 of the EIS. There would be differences in the proposed road system under each alternative, as summarized below. The general types of activities that would occur under each alternative in relation to roads would be similar, however.

Access to the NFS portion of the NSJB CBM Project would be from existing roads including U.S. Highway 160, State Highway 151, La Plata County Roads 525 and 527, and NFSRs 123, 132, 537, 608, 613, 615, 743, and 756. Some existing unimproved NFS roads associated with this project would require reconstruction, particularly near NFS road 615 and 615. A network of new roads would be constructed. The Companies propose to construct 92 miles of collocated access roads and pipelines to serve the well pads on NFS lands. The road-related activities of each of the major phases of the project are discussed below.

After the proposed roadwork is complete, the densities of the FS roads classified as "open" in each Management Area would not change from the existing densities (summarized in Table 3–141). The only access roads that would be open are classified as open under the proposed Travel Management Plan. All other roads constructed or upgraded for CBM facility access would be classified FS Closed to public motorized use. Changes to Travel Management Areas in the Project Area are discussed in the Recreation Section 3.12.3.1.1, Alternative 1 — Proposed Action.

*Decommissioning and Reclamation*

When the project is complete, all roads constructed specifically for the project would be removed, with the exception of those roads that remain open to the public during the duration of the project and those that the Forest Service retains for administrative purposes. The road system open to public use under the proposed travel management plan is depicted in Figure 3–52. Roads that are not needed for further use would be blocked, re-contoured, reclaimed, and vegetated consistent with the requirement of the FS (according to Onshore Oil and Gas Order No. 1, Approval of Operations). Gravel surfaces would be removed. Disturbed areas would be backfilled as needed and graded to the desired configuration. Erosion control features would be installed to stabilize the surface, if necessary. Roads would be revegetated with a seed mixture authorized by the FS and certified as weed free. Commercial seed either would be certified or registered. Seeding and planting would be repeated until satisfactory revegetation is achieved.

## 3.13.3.2 Alternative 1A

Alternative 1A would require 94 miles of new access roads, which is 20 percent fewer road miles than the 118 miles proposed for Alternative 1. The impacts to the regional road system within the Project Area are similar to Alternative 1, but are of a smaller magnitude. The number of trips made by construction vehicles on county road and highway segments is the same for all roads under Alternative 1A as under Alternative 1, with the exception of the segment of CR 527 – CR528 north to end. Alternative 1A would result in approximately 50 percent fewer vehicle trips than under Alternative 1 on segments of CR 527 – CR 528 north to end and about 8 percent fewer trips on all county roads and highways. The increase in daily traffic trips would be below the significance levels for all road segments and would be less than 1 percent on all highways and most county road segments.

None of the proposed access roads would be open to public uses on NFS lands. All roads are currently open, but the majority will be closed to motorized use with the proposed change in travel management. The density of open roads in the Management Areas would not increase from Alternative 1A.

The impacts on county road congestion, the probability of accidents, and the level of damage to road surfaces by heavy truck traffic would be similar to Alternative 1 but would occur to a lesser degree, as the alternative would entail about a 20 percent decrease in miles of access roads relative to Alternative 1. A smaller number of construction trips would be required, resulting in less traffic by construction vehicles on highways, county roads, and public access roads on federal lands.

### 3.13.3.3 Alternative 1B

The number of new access roads on NFS lands would be smaller under this alternative because the drilling scenario would require a smaller number of pads. Alternative 1B would require 62 miles of new access roads, which is 47 percent less road miles than the 118 miles proposed for Alternative 1. None of the proposed access roads would be open to public uses on NFS lands. The impacts to the regional road system within the Project Area are similar to Alternative 1 but are of a considerably smaller magnitude. The number of trips made by construction vehicles on county road and highway segments is less for all roads under Alternative 1B as compared with Alternative 1.

The impacts on county road congestion, the probability of accidents, and the level of damage to road surfaces by heavy truck traffic would be similar to Alternative 1 but would occur to a lesser degree because fewer pads on NFS lands would require a smaller number of trips made on county roads, resulting in less traffic by construction vehicles on highways, county roads, and public access roads on federal lands.

### 3.13.3.4 Alternative 2

Under Alternative 2, access to the Project Area would be the same as for Alternative 1; however, there would be a larger number of miles of access roads (203 miles) constructed than proposed for Alternative 1. None of the proposed access roads would be open to public uses. Maximum development would require more construction and maintenance traffic. There are 76 percent more facilities, which would result in 76 percent more vehicle trips for construction and maintenance that would affect traffic levels on the regional road system within the Project Area. Alternative 2 would have the largest impact of all the alternative scenarios for well development because it would result in the greatest increases in traffic levels and potentially higher accident rates on public roadways. There would also be higher levels of road degradation, resulting in the greatest increase in maintenance costs of all the alternatives.

### 3.13.3.5 Alternative 3

Access to the Project Area would be the same as for Alternative 1. The companies propose to construct 78 miles of access roads to serve the well pads. None of the proposed access roads would be open to public uses. The impacts to the regional road system within the Project Area are similar to Alternative 1, but the magnitude of traffic impacts and land disturbance from construction of access roads is reduced. There are 23 percent fewer facilities, which would result in 23 percent fewer vehicle trips for construction and maintenance that would affect traffic levels on the regional road system within the Project Area.

#### 3.13.3.6 Alternative 4

Under Alternative 4, access to the Project Area would be the same as for Alternative 1. The alternative would require constructing 91 miles of access roads to serve the well pads. The impacts to the regional road system within the Project Area are similar to the type of effects described for Alternative 1, but the magnitude of traffic impacts and land disturbance from construction of access roads is reduced. There are 34 percent fewer facilities, which would result in 34 percent fewer vehicle trips for construction and maintenance that would affect traffic levels on the regional road system within the Project Area.

#### 3.13.3.7 Alternative 5 — No Action

This alternative would involve constructing 40 miles of access roads and pipelines to serve the well pads. The impacts to the regional road system within the Project Area are similar to the type of effects described for Alternative 1, but the magnitude of traffic impacts and land disturbance from the construction of access roads is reduced. There are 58 percent fewer facilities than Alternative 1, which would result in 58 percent fewer vehicle trips for construction and maintenance that would affect traffic levels on the regional road system within the Project Area. Road access on NFS and BLM lands would remain unchanged. The density of open roads for NFS Management Areas under Alternative 5 would not increase under this alternative. Alternative 5 has the smallest impact to traffic and road densities of all the alternative scenarios for well development.

### 3.13.4 Cumulative Effects

Relatively small levels of direct effects to the primary access routes within the Project Area, including state, FS, and county roads, would occur as a result of project-related vehicular traffic associated with implementation of any of the alternatives. Continued CBM development in the Project Area is not expected to significantly impact traffic congestion or accident rates. Traffic rates on county roads that would be most heavily used by proposed CBM traffic are expected to increase between 50 and 137 percent between 1998 and 2020, primarily as a result of residential growth on private land in the Project Area. Oil and gas development would contribute to increased traffic on these roads to a lesser degree than would population growth.

The SUIT Study Area, which is located next to the south side of the Project Area, was evaluated for traffic congestion and accident rates resulting from CBM traffic on roads used by the public in the Study Area. The SUIT analysis found that the alternatives resulted in no perceivable incremental traffic impacts on residents in the Study Area. CBM traffic from existing and proposed operations in the SUIT area would not generate additional traffic in the Project Area. CBM traffic in the SUIT Study Area would not use any of the county roads and highways that would be used under any alternative in the Northern San Juan Basin Project Area. Therefore, there would be no incremental effects to traffic congestion and accident rates from cumulative oil and gas development on individual county roads and highways within the Project Area from SUIT CBM traffic. Cumulative effects would occur primarily from existing and projected traffic within the Project Area.

The greatest increases in traffic volume from cumulative (existing and anticipated) CBM construction and maintenance traffic would occur on segments of CRs 223, 228, 501, 502, 504, 505, and 527, and U.S. Highway 550. With the exception of CR 527, these roads are the same as are used to access existing and future residential development. A significant impact on the volume of traffic would exist if anticipated CBM development were projected to generate 25 percent or more additional daily vehicle trips. Traffic from CBM development would have no perceivable impact if it generates less than 10 percent of additional vehicle daily trips. Table 3–148 summarizes daily trips associated with existing and projected CBM wells under Alternative 1 in the Project Area, and compares the trips with the ADT volume of all vehicle types for 1998 and the projected 2020 ADT for selected roads in La Plata County. The table shows that increases generated by cumulative CBM maintenance traffic are less than 10 percent of additional average daily trips on most of the selected segments of county roads.

**Table 3–148 Cumulative Access Roads for Each Alternative**

| | Total Length by Alternative (miles) | | | | | | |
|---|---|---|---|---|---|---|---|
| Roads | 1 | 1A | 1B | 2 | 3 | 4 | 5 |
| Existing | 191 | 191 | 191 | 191 | 191 | 191 | 191 |
| Alternative | 118 | 94 | 62 | 203 | 78 | 91 | 40 |
| Cumulative | 310 | 285 | 253 | 396 | 272 | 286 | 236 |
| Increase | 62% | 48% | 32% | 106% | 41% | 48% | 21% |

The cumulative transportation effects would include an increased risk of traffic accidents in proportion to the amount of increased daily traffic for any of the alternatives. The number of traffic accidents has increased on some county roads in areas of existing CBM development. The potential for conflicts with CBM-related traffic is highest along roads used to access existing and future residential development. Two of these roads (CRs 228 and 501) were identified as high accident locations, as discussed in Section 3.13.2.3. However, rates of traffic accidents would increase because of an increase in the volume of traffic, which is not expected to be significant. The cumulative transportation effects of traffic congestion and accident rates would not be significant for any roadways in the Project Area and would have no perceivable impact on any roadways, with the exception of CR 223, which would experience an increase in daily traffic levels of about 16 percent at the beginning of production activities.

Increased degradation of existing roadways may result from any of the alternatives when incremental effects of proposed CBM traffic are added to existing CBM and other traffic. Based on the distribution of the well locations for each alternative, wear and tear on county roads and classified open FS roads would likely occur.

Table 3–148 summarizes the cumulative number of CBM access road miles from existing and projected CBM development in the Project Area. The SUIT analysis did not evaluate the increase in the number of access road miles; therefore, the cumulative access road miles shown in Table 3–148 include only cumulative access road miles from CBM development within the Project Area. There would be no increase in the miles of road open to the public on federal, state, and private lands, as all proposed access roads would be closed under all of the alternatives.

## 3.13.5 Mitigation and Monitoring

This section provides options for mitigating the impacts to traffic and transportation associated with the anticipated CBM development. Unless otherwise stated, the following measures will be funded by the Companies.

The primary impacts identified are a minimal increase in daily traffic and associated slightly increased risk of accidents during construction and operation of the CBM facilities. Other impacts include increased wear and tear on FS roads and bridges, county roads, and county bridges caused by additional traffic and heavy equipment vehicles during construction of new CBM facilities.

Heavy truck traffic would account for the majority of CBM construction vehicle trips. Construction vehicles would damage road surfaces to a greater degree than is indicated by the small increases in overall traffic volume. Heavy truck traffic would result in increased costs for road maintenance because heavy trucks cause more damage to road surfaces relative to automobiles and light trucks.

### 3.13.5.1 NFS Roads

Mitigation measures for new access roads constructed on federal lands include:

- Operators shall conduct maintenance of all access roads authorized through a lease or right-of-way. Construction and maintenance are to comply with landowner requirements or agency standards. Maintenance includes, but is not limited to, blading, cleaning ditches and drainage facilities, controlling noxious weeds, or other requirements as directed by the landowner or agency.
- Construct road barriers or signs to discourage public use of well access roads.
- Reclaim access roads following project completion and revegetate in accordance with agency regulations and landowner agreements.
- Mitigate dust by spraying water on roads as needed.

### 3.13.5.2 County Roads

Mitigation of county road impacts is accomplished through county road maintenance that is supported through revenues derived from property tax assessments, energy impact assessment grants, and permit fees for overweight/oversized vehicles. The magnitude of these oil and gas companies' derived revenues is presented in Section 3.16 — Social and Economic values. Any further regulation would be a matter of state or county regulatory rulemaking.

## 3.13.6 Conformance to Existing Plans and Policies

The proposed new and reconstructed access roads would be maintained to a minimum standard of road maintenance level three, which is typically low speed, single lane with turnouts and native or aggregate surfacing. For all alternatives, open road density guidelines may be exceeded in Management Areas 6B, primarily in the Sauls Creek area. Roads to access well locations would also be constructed in Management Areas 5B, which are present in Spring Creek and Fosset Gulch. These roads are not consistent with general direction and guidelines for Management Area 5B, which allow for new roads within the management area only to meet priority goals outside the management area.

## 3.13.7 Unavoidable Adverse Effects

Unavoidable adverse effects associated with construction and operation of the road system include resultant soil erosion, potential for mass wasting, and wildlife impacts. These unavoidable adverse effects are presented n the Soils and Wildlife sections, respectively.

## 3.13.8 Irreversible and Irretrievable Effects

Irreversible or irretrievable commitments of resources are addressed in the Soils and Wildlife Sections, respectively. In terms of commitment of land to roads, the impact would be reversed after project completion in about 25 years. At that time, the vast majority of roads constructed for this project would be obliterated and returned to prior use. The productivity of the reclaimed sites would generally not equal pre-construction condition, however.

# 3.14 Visual Resources

## 3.14.1 Issues

*Issue 9: The effect of additional CBM development on the Project Area's scenic values.*

- Will CBM development exceed the BLM and FS' visual management guidelines?
- How will further CBM development visually alter the landscape when viewed from sensitive viewpoints (highways, roads, and residential areas)?
- How will construction and operation of pipelines, power lines, fences, and roads affect visual quality?
- How will the contrast from flaring affect the rural area?
- How will nighttime lighting at compressor stations affect the scenic values of night-sky darkness of the area?

## 3.14.2 Affected Environment

Most of the Project Area is considered moderately scenic. Because of the varied topography, much of the Project Area is visible from a variety of sensitive viewing areas. Areas that are visible from many locations or at close range are considered the most sensitive to modifications of the landscape.

Public sensitivity to landscape modification is relatively high. Reflecting this sensitivity, current objectives for management of visual resources on public land control the degree of alteration that may be allowed in the landscape. Sensitivity values are based on a combination of visual exposure, viewing distance, and the number of people who view the area.

### 3.14.2.1 Landscape Character

#### *3.14.2.1.1 Baseline Conditions*

The landscape character was identified using:

- The Visual Quality Objectives (VQO) map developed for the Project Area (FS 2003d),
- The Durango 1993 BLM edition topographic map (BLM 1993),
- Aerial photography for the San Juan National Forest map (FS 1994a), and
- Maps of data or vegetation and observations during site reconnaissance.

The variety of landscapes in the Project Area draws people to live, work, and recreate. The western portion of the Project Area is characterized by rolling hills, mesas, plateaus, and hogbacks, interspersed with broad to narrow drainages. The eastern portion of the Project Area consists of mountainous terrain mixed with upland hills, rolling uplands, ridges, and narrow valleys, as well as river valleys.

The vegetation varies with location in the Project Area. In the western portion, it ranges from agricultural cropland at lower elevations to desert shrub, desert woodland, mountain shrub, and conifer woodland at the upper elevations. Vegetation in the eastern portion of the Project Area consists primarily of piñon/ juniper, oak, and coniferous vegetation. The soils and rock formations also add to the variety of landscapes.

Several waterways are used for recreation and are viewed by residences and motorists. Major waterways in the Project Area consist of the Florida and Los Piños Rivers. The Florida River is located along the eastern edge of Florida Mesa and eventually flows into the Animas River south of the Project Area. The Los Piños River flows north to south, just west of Bayfield. The Piedra River is a major tributary east of the HD Mountains and outside the Project Area.

### *3.14.2.1.2 Existing Landscape Modifications*

Throughout the Project Area, the landscape has been modified by agricultural, residential, commercial, transportation, and oil and gas development. The degree of modification from these land uses varies, depending on the location in the Project Area and the types of modifications. Agricultural development causes a break in native vegetation, which creates a visual contrast in color and texture. Residential development generally consists of low-density and rural housing, with a few areas of high density that create a major modification of the landscape. The scenic quality is decreased as a result of the alteration in the landscape. Typically, transportation corridors are primary areas of residential, commercial, and industrial development. The linear effect of roads also alters the character of the landscape, because roads are likely to attract the attention of a viewer with the contrast in color, form, and texture, as well as the activity associated with the corridors.

Oil and gas development has modified the character of the landscape because native vegetation is cleared and industrial-like components are put in place, which can attract attention. These impacts are discussed in the subsection that describes CBM Development to Date (starting on page 3–364).

### *3.14.2.1.3 Visual Classification Systems Relevant to the Project Area*

We analyzed all federal, state, and private land in the Project Area with the Forest Service's Visual Management System (VMS), described below. The BLM generally inventories and manages visual resources with the BLM Visual Resource Management (VRM) system. The VRM is similar to the FS VMS in that both use fundamental principles of design (form, line, color, and texture) to quantify resource values by inventory, set objectives, and evaluate impacts on a landscape. However, because BLM land in the Project Area has not been inventoried for visual resources, and to maintain consistency in the analysis of the visual resource process, the FS system was expanded to include BLM, private, and state land. The process was used to assess the existing visual resource and analyze potential impacts on characteristic landscapes for the entire Project Area. However, the FS applies management objectives associated with each FS VMS classification only to federal land.

FS VQOs describe the degree of acceptable alteration of the natural landscape, based on the importance of scenic values as indicated by the VMS process. VQOs are based on diversity of natural features (variety class) and the public's concern for scenic quality (sensitivity levels). These objectives include Preservation, Retention, Partial Retention, Modification, and Maximum Modification.

Three of the five possible VQOs were mapped in the Project Area as a result of the process: Retention, Partial Retention, and Modification. The Retention VQO provides for management activities that are not visually evident and that repeat only the form, line, color, and texture that are frequently found in the characteristic landscape. The Partial Retention VQO allows for activities that remain visually subordinate to the characteristic landscape. The Modification VQO allows for activities that may visually dominate the original characteristic landscape. These activities must, however, borrow from naturally established form, line, color, or texture, so that the visual characteristics are like the surrounding area.

### *Visual Objectives within the Project Area*

The Project Area's VQOs were developed and mapped using the process outlined in Volume 2, Chapter 1, Forest Service, Department of Agriculture Handbook 462, *The Visual Management System* (FS 1974). Variety classes were established using previous mapping of the area for past management activities, as well as the 1983 SJNF LRMP. The Project Area was inventoried in the field during the summer of 2002 to delineate the three variety classes. The sensitivity level of all travelways and use areas had been rated in 1992.

The analysis assumed that landowners would exhibit major concern for aesthetics and the scenic quality of their land and the land around them. This assumption resulted in high sensitivity levels. As a result, much of the private land in the western portion of the Project Area has been assigned a VQO of Retention. The federal land in the eastern portion of the Project Area generally was rated with lower sensitivity levels, which resulted in the VQOs of Partial Retention and Modification. Figure 3–53 shows the distribution of the Retention, Partial Retention, and Modification VQOs mapped in the Project Area. Table 3–149 shows the distribution of VQOs by land ownership.

**Table 3–149 Distribution of Visual Quality Objective Classifications by Surface Ownership**

| | Areal Extent of VQO by Ownership | | | | |
|---|---|---|---|---|---|
| VQO Classification | BLM (acres) | FS (acres) | State (acres) | Private (acres) | Total (acres) |
| Retention | 3,003 | 7,950 | 3,209 | 48,730 | 62,892 |
| Partial Retention | 2,122 | 22,663 | 1,249 | 16,042 | 42,076 |
| Modification | 1,548 | 18,770 | 4 | 57 | 20,379 |
| Total | 6,673 | 49,383 | 4,462 | 64,829 | 125,347 |

### 3.14.2.1.4 Impacts of CBM Development to Date

Oil and gas development in the Project Area is not evenly distributed among the three VQOs. About 4 percent of existing development is in the areas mapped with the Modification VQO. Another 24 percent is in areas mapped with the Partial Retention VQO. Most (72 percent) of the existing oil and gas development occurs in areas mapped with the Retention VQO.

Most of the development in areas classified for Modification meets the objectives of the classification, because it accommodates changes that visually dominate the original characteristic landscape. Facilities in the foreground, middle ground, and background perspectives or distance zones all meet this objective.

Some, but not all, of the oil and gas development in areas classified as Partial Retention is consistent with that VQO, which accommodates activities that are visually subordinate to the characteristic landscape. Consistency with the objective of Partial Retention primarily depends on the distance zone where the facility is located. Based on field observations in the Project Area, facilities located in the background and middle ground distance zones are typically subordinate or unnoticed and meet the objective of Partial Retention, but facilities in visually exposed areas in the foreground often do not.

Most of the oil and gas development in the foreground distance zone does not meet the objective of Retention, which accommodates modifications that are not visually evident and only repeat the line, form, color, and texture in the landscape, because it is visually prominent. The Retention objective is generally met in the middle ground and background distance zones, because these facilities are unnoticed or subordinate to the landscape.

In many cases, the oil and gas development in the Project Area has achieved the applicable VQOs using visual-mitigation techniques, which can substantially reduce the visual prominence of many facilities and related disturbance. Based on observations of oil and gas development in the Project Area, well pads typically have been recontoured and reclaimed so that the form, line, color, and texture of the characteristic landscape are repeated. The locations of the pads have been bermed and revegetated immediately, to reduce the duration of visual impacts. In most instances, facilities have been painted to meet BLM and FS specifications for color associated with soils and vegetation.

The linear features associated with pipelines that are routed cross-country make visual objectives more difficult to meet than do the locations of surface well pads. Often, the form, line, color, and texture are, for the most part, repeated, but contrast with vegetation, and the linear nature may remain evident. Typically, roads have been constructed to blend with the topography, and cuts and fills are revegetated.

## 3.14.2.2 Sensitivity of Landscape Viewshed

### *3.14.2.2.1 Baseline Conditions*

"Sensitivity of landscape viewshed" is the extent that features are noticeable or apparent in the landscape. Distance and screening profiled by topography are two aspects considered in evaluating the sensitivity of the landscape viewshed.

We identified sensitive viewing areas to facilitate the analysis of sensitivity of the landscape viewshed. As shown in Figure 3–54, these viewing areas were primarily in three representative land use-categories: recreation/open space, transportation corridors, and residential areas. These three land-use categories represent the uses of public and private land in the Project Area and contain most of the viewers who would be concerned about the scenic quality of a landscape. Land uses in the remainder of the Project Area consist of agriculture, which includes sparsely scattered rural residences, state land that is not designated for specific land uses, and isolated parcels of BLM land. A small number of viewers in these areas are concerned about the scenic quality of the landscape.

In coordination with staff of the BLM, the FS, and La Plata County, the sensitive residential viewing areas shown in Figure 3–54 were identified as representative "visual receptors" (locations where humans "receive" the impacts, such as at a residence) in each land-use category. Polygons (circles) that depict representative land-use areas were digitized (mapped) on a topographical map for inclusion in Figure 3–54. The polygons represent areas where the majority of residents or visitors to the Project Area would view existing oil and gas development.

Sensitive points delineated in the Project Area included a variety of residential areas. These viewing areas were identified based on the subdivisions in La Plata County.

Fewer travel routes and recreational areas were identified as sensitive viewpoints. Travel routes identified as sensitive viewpoints include U.S. Highway 160; La Plata County Roads 228, 172, and 521; and National Forest System Roads 537, 613, and 608. Recreational areas so identified include the Grandview Ridge Trails on BLM land and the HD Mountains on NFS land.

Photographs of gas facilities located in each land-use category were taken from the sensitive viewing areas shown in Figure 3–54. The 17 photographs in Figure 3–55 through Figure 3–71 show the appearance of gas production facilities and other industrial development of low- and high-density residential subdivisions, recreation areas, and roads. The photographs show oil and gas facilities in the foreground and middle ground distance zones. The foreground includes distances ranging up to 0.5 mile from the viewer. Middle ground includes distances from 0.5 to 3-to-5 miles from the viewer. According to the viewshed analysis from sensitive viewpoints, a large portion of the Project Area is visible from these locations, as shown in Figure 3–72. The photographs represent the appearance of typical CBM well development that occurs in these land uses throughout the Project Area.

### 3.14.2.2.2 CBM Development to Date — Sensitivity and Frequency of Existing Well Development and Associated Facilities

We assessed existing oil and gas development based on photographs of the foreground, middle ground, and background distance zones from sensitive viewing areas in three land-use categories: recreation/open space, transportation corridors, and residential, as shown in Figure 3–55 through Figure 3–71. In addition to the visible components of the equipment, construction-related dust is visible during well construction and generated by traffic related to oil and gas on unpaved roads.

For this analysis, the existing visual impact of oil and gas development includes various components, such as:

- Well heads
- Separators
- Meter house
- Pump jacks
- Dehydrators
- Condensate tanks
- On-site water storage tanks
- Uncovered pits for produced water
- Covered pits for produced water
- Cathodic protection wells
- Water injection well facilities
- Compressor stations
- Access roads
- Gathering pipelines
- Pipelines and well pads
- Utility lines
- Fences and signs

#### *Visual Impacts of Well Components and Compressors*

Existing visual modification of the Project Area has occurred from well facilities described in the preceding list of components in the foreground, middle ground, and background distance zones, as viewed from sensitive viewing areas. The photographs show that the degree of impact on viewers at any of the sensitive viewing areas from existing facilities depends on the availability of natural screening in the surrounding landscape, as well as on the distance zones. It was not feasible to obtain photographs in all land-use categories in the middle ground and background for most of the existing facilities, because topography and vegetation blocked views from many sensitive viewpoints.

Most of the visual impacts occur in foreground views up to 0.5 mile from viewers. The facilities are readily visible to an observer at nearby residences, recreational areas, highways, and county roads. Solid geometric and angular forms, such as meter houses, pump jacks, condensate tanks, on-site storage tanks, and covered pits for produced water, are prominent in the foreground, as shown in Table 3–150.

### Table 3–150 Visual Characteristics of Existing Well Development

| Well Facility (CBM and Conventional) | Frequency of Occurrence[1] | Foreground (0–0.50 miles)[2] | Middle Ground (0.50–3 to 5 miles)[2] | Background (middle ground to infinity)[2] |
|---|---|---|---|---|
| Well head | Common | P | U | U |
| Separator | Common | P | U | U |
| Meter house | Common | P | U | U |
| Pump jack (CBM) | Moderate | P | U | U |
| Dehydrator | Sporadic | P | U | U |
| Condensate tank | Sporadic | P | S | U |
| On-site water storage tanks | Moderate | P | S | U |
| Uncovered pit for produced water | Sporadic | S | U | U |
| Covered pit for produced water | Sporadic | S | S | U |
| Cathodic protection well | Sporadic | S | U | U |
| Support facilities | | | | |
| Water injection well facilities | Sporadic | P | P | S |
| Compressor station/gas plant | Sporadic | P | P | S |
| Linear elements | | | | |
| Access roads | Common | P | P | S |
| Gathering pipeline | Common | P | P | S |
| Transmission pipeline | Common | P | P | S |
| Well pad | Common | P | S/P[3] | U/S[4] |

Notes:

1. Sporadic occurrence = very few structures; Moderate occurrence = found with only one type of well, optional components of well; Common occurrence = widespread, common distribution of wells.
2. P= prominent – dominates surrounding setting; S = subordinate – begins to attract attention, U= unnoticed – does not attract attention.
3. S if partially reclaimed, P if not partially reclaimed.
4. U if partially reclaimed, S if not partially reclaimed.

The table also lists facilities that are subordinate to the landscape in foreground views because they have a lower profile, making them visible primarily to viewpoints that are higher in elevation. These facilities, which include covered and uncovered pits for produced water, occur sporadically throughout the Project Area.

The contrast in color, line, and form of prominent facilities can be blended to some degree when it is appropriately mitigated (through paint, reclamation, or siting, for example) with the features of the existing landscape. Figure 3–55, Figure 3–56, Figure 3–57, Figure 3–58, and Figure 3–59 show well facilities that have been sited so that the existing vegetation provides a backdrop as seen from sensitive viewpoints. These facilities have been painted colors that harmonize with the existing vegetation, eliminating color contrasts and reducing the contrast of the angular, geometric forms of the facilities with the surrounding natural environment.

Well facilities in foreground views where there is no natural vegetative or topographic screening are more noticeable to viewers, as shown in Figure 3–60 The pump jack in the photograph is situated so that the existing vegetation was not used to screen the facility or provide a backdrop from portions of County Road 228. As a result, the pump jack is easily seen from portions of County Road 228, because of its strong contrasts in color and geometric form with the surrounding light colors of the landscape.

In Figure 3–61, the pump jack is silhouetted against the backdrop because it is larger than the surrounding vegetation, and the angular lines appear prominent against the homogenous textures of the backdrop terrain.

Figure 3–62 shows an approved well site where the facilities have not yet been installed. Once the facilities have been installed, they will present strong contrasts with the surrounding landscape, because of the lack of any natural screening.

In the middle ground distance zone, the geometric forms of wellhead facilities are visible but difficult to discern when they are mitigated to minimize contrasts in color. The wellhead facilities in the middle ground distance zones shown in Figure 3–63, Figure 3–64, Figure 3–65, Figure 3–66, and Figure 3–67 have been painted to harmonize with the surrounding vegetation. This paint eliminates contrasts in color and reduces the contrast of the angular, geometric forms of the facilities with the surrounding natural environment.

Existing oil and gas facilities are generally not visible in the background, which includes developments more than 3-to-5 miles from the viewer. Table 3–150 shows that most facilities in background distance zones do not attract the attention of viewers. At these distances, the scale of the facilities is small, relative to the surrounding landscape. Therefore, the forms, lines, and colors of the facilities are indistinct and blend into the landscape.

Some well pads and linear components such as access roads and pipeline clearings are subordinate to the landscape because of their small scale, relative to landscape elements in foreground and middle ground distance zones; however, sharp contrasts between cleared areas and surrounding dense vegetation may be visible in background distance zones before the sites are reclaimed. When they are appropriately mitigated through reclamation or siting the facilities to use the existing terrain or vegetation for screening, they are generally unnoticed by the casual observer in the background views.

Although support facilities such as water injection wells and compressor stations occur less frequently than wells, often they are more noticeable to the casual observer, because of their size. The six injection wells and six compressor stations within the Project Area can be up to 25 feet tall and 15 feet wide. These facilities can be prominent in the near-middle ground distance of about 0.5 mile, although they are generally subordinate to the landscape in the 1- to 5-mile distances of the middle ground zone.

Table 3–150 shows that these facilities occur sporadically in the Project Area. Both types of facilities are prominent in foreground views, are easily visible in middle ground views, and are often sporadically visible in background views. The compressor station in Figure 3–68 is visible to viewers at a distance of 1 mile; as seen from the highway; however, the compressor repeats the lines and forms of other buildings in the viewshed and cannot be identified as a CBM production facility.

### *Visual Impacts of Linear Features and Well Pads*

Development of linear facilities, such as oil and gas pipelines and roads, can involve clearing dense vegetation and construction on steep slopes. Access roads and well pads present an obvious contrast in color with the surrounding vegetation, as shown in Figure 3–55, Figure 3–57, and Figure 3–69. These cleared areas are typically prominent in the foreground, middle ground, and background views.

Because of the low profile of pipeline clearings and roads, the contrasts of color and the linear form with the landscape are easily screened with surrounding vegetation and topography in middle ground and background views. Generally, linear features are more likely to attract attention when the observer is at a higher vantage point (for example, in rolling hills) rather than on flat landscapes, where the observer is parallel with the activity, and views are easily screened. Typically, roads make up a considerable amount of the disturbance associated with oil and gas facilities.

A well pad may tend to be more sensitive to the viewer immediately after construction, because of the amount of exposed surface. The sensitivity will likely decrease as the disturbed surface begins to blend in color, form, and texture when interim reclamation (recontouring of slopes and seeding) occurs. Well pads and access roads are the most obvious feature of CBM development in the middle ground distance zone, as shown in Figure 3–65 and Figure 3–70 and in the foreground distance zone (Figure 3–71).

Well pads and roads are visible as light brownish-gray, geometric clearings with straight, linear edges that obviously contrast with the surrounding vegetation. Well pads that are partially reclaimed are subordinate in the middle ground and unnoticed in the background, as shown in Table 3–150. Conversely, well pads that are not reclaimed (exposed cuts and fills) are generally prominent in the middle ground and subordinate in the background views.

### *Sensitivity to Existing Flaring and Compressor Lighting*

Other elements that increase sensitivity include activities or components of the facility that result in lighting contrasts. These activities include flaring and lighting from compressor stations. The contrasts from these activities are a result of increased sensitivity at night and are more likely to be viewed in middle ground and background views, more so than during the day.

Flaring associated with well testing, results in a flame that can be noticeable to the casual observer in many distance zones, depending on the terrain. Flaring is a common practice that occurs only when the well is being developed. The activity is commonly visible in most distance zones in rural, agricultural, and undeveloped land during the evening (assuming they are not screened by topography, structures, or vegetation), because of the sharp contrast of the flame. During the day, this activity would likely be viewed only in the immediate foreground and foreground distance zones. Flaring draws the attention of a viewer in the middle ground and background distances in the evening, when the contrast of fire against the dark of night is stark.

Flaring does not usually create smoke or plumes that would be noticeable from background distances. The increased visual sensitivity to flaring is more often a result of the perceived hazard associated with fire, as opposed to the decrease in visual quality. It is estimated that only one to three wells would be flaring at any one time in the Project Area. Flaring is a short-term effect that typically lasts 3 to 5 days at each new well site.

Nighttime lighting of compressor stations also results in increased viewshed sensitivity. Permanent nighttime yard lighting is typically installed for safety and security to employees, or to protect the public and prevent tampering with the station by the public. Typically, this lighting consists of low-pressure sodium vapor fixtures arranged around the site so that the equipment can be safely operated during darkness.

The lighting systems at the compressor locations are light sensitive and automatically turn on in the evening. This lighting has been arranged to reflect away from any nearby properties and from the vision of passing motorists or recreationists. Of the six existing compressors in the Project Area, five are in the western portion, where most of the current residential development exists. Based on the level of residential development in this portion of the Project Area, lighting from these facilities may not draw the attention of casual observers.

## 3.14.3 Environmental Consequences

The project's visual impact depends on the amount of visual contrast it creates, relative to the existing characteristics of the landscape. Short-term impacts would occur where construction-related equipment, activities, and dust would be visible to observers. Long-term impacts would occur when vegetation is removed; the landscape is altered by construction of CBM well pads and roads; and facilities and equipment, such as wellheads and compressor stations, are installed. Vegetation removal, alteration of the landscape, and installation of equipment and facilities would introduce changes in the line, form, color, and texture of the landscape.

The types of visual impacts are generally similar for each alternative, but are magnified in alternatives that involve more wells and are not as evident in alternatives with fewer wells. In addition, some alternatives would exclude CBM development from portions of the Project Area. As a result, visual impacts would not occur in these areas, under those alternatives. The following discussion describes visual impacts as they relate to the issues raised during scoping that would occur with implementation of the alternatives.

### 3.14.3.1 Visual Impacts and Conformance with BLM and FS Visual Management Systems

A concern raised during scoping was whether additional development of CBM would conform to the policies and objectives of the BLM and FS visual management systems. The analysis of each alternative below addresses visual impacts and this conformance issue. Because the entire Project Area was inventoried using the FS VQO system, visual impacts were assessed based on conformance with the objectives of the FS visual management system, and not the BLM VRM classification system.

### 3.14.3.1.1 Alternative 1 — Proposed Action

Long-term impacts from Alternative 1 would result from the addition of the wells and access roads to the landscape and the permanent disturbance of land that would be used for associated facilities, such as gathering lines, well service roads, and access roads. The most visible component of the proposed facilities would be the pumping units at each well site. Gas-gathering and water pipelines would be buried adjacent to rights-of-way for existing and new roads.

Alternative 1 would impact almost 672 acres, or 0.5 percent of the Project Area. Some 296 wells on 273 pads, 6 water disposal wells, and 14 compressors would be developed in the Project Area. About 60 percent of these facilities would be on federal land. A total of 100 miles of new road would be developed, with most of the new roads (76 miles) developed on federal land. Impacts would be distributed fairly equally among the three VQO classifications in the Project Area (Table 3–151).

**Table 3–151 Distribution of Impacts Caused by Each Alternative by Visual Quality Objective**

| Visual Quality Objective | Disturbance[1,2] by Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 (acres) | 1A (acres) | 1B (acres) | 2 (acres) | 3 (acres) | 4 (acres) | 5 (acres) |
| Retention | 208 | 209 | 172 | 385 | 198 | 165 | 144 |
| Partial Retention | 212 | 188 | 149 | 466 | 131 | 179 | 51 |
| Modification | 251 | 221 | 153 | 308 | 136 | 128 | 49 |
| Total[3] | 672 | 617 | 475 | 1,158 | 465 | 472 | 244 |

Note:

1. Includes all wells, pads, roads, pipelines, disposal wells, and compressors on NFS, BLM, State, and private lands.
2. Does not include facilities at undetermined locations or located outside the Project Area.
3. Totals may not match precisely with values obtained by adding unit numbers based on rounding conventions.

During the 6- to 12-day construction period, the presence of heavy equipment and dust generated by construction and traffic would detract from the visual quality of the landscape at each well location. These actions could conflict with residential and recreational uses because they would be visually and audibly intrusive. Night lighting would also be visible during this period, because drilling occurs on a 24-hour basis. Visual impacts would be greater for well locations near residential areas, along roads, and in open areas that are not screened by topography or vegetation. Construction would be spread over the 5-year construction phase.

After construction is complete, well pads, new access roads, and pipeline and utility trenches would all appear as visible alterations of the landscape. Exposed soils and rock would replace landscapes that had previously been covered with natural appearing vegetation. These disturbed locations would present a visible contrast to the observer for a period of several months to several years. The duration of this impact would depend on the success of revegetation.

The addition of wells and associated access roads would result in a mixed rural and industrial landscape. Development in the western portion of the Project Area would incrementally alter an already modified landscape character (changed by residential, commercial, agricultural, and gas well development). The components with the highest potential to affect the visual character of the area adversely are the well pad clearings, pumping units, access roads, and pipelines. Operation of the proposed facilities would introduce new elements of form, line, color, and texture into the landscape and would essentially dominate foreground views. They would be visible in middle ground and background views in flat areas that are less vegetated.

There would be 100 miles of proposed access roads and gathering lines in the Project Area. More viewers would observe the visual impacts of road construction in the western Project Area because of the greater residential density. Most of the proposed roads in the western portion of the Project Area would be relatively short, because the existing network of local and oil and gas roads can be accessed for proposed development. The topography is relatively flat in the area and would not result in large cuts and fills, which often attract attention until they are reclaimed. Exposed earth associated with these roads would visually contrast with adjacent, vegetated surfaces in terms of line and color over the life of the project.

Each compressor station would be lighted at night for safety. Each light would be mounted on a pole or building and would be oriented downward to illuminate the facility. This type of lighting would minimize the night shine from the facility. However, the compressors nearest to the residential areas would be visible at night.

When abandoned, the facilities would be removed and the wells plugged. The entire pad would be contoured to blend with the existing topography if it requires regrading and reseeding. The visual disturbances from construction of well pads, roads, facilities, and pipelines vary, depending on the topography, adjacent vegetation, soil types, and nutrient contents that ultimately control the level of successful reclamation. These changes to the landscape in form, line, color, and texture would remain for an undetermined period.

As described in Table 3–150 and illustrated in Figure 3–54, visual contrasts associated with CBM structures and facilities would be most prominent in foreground views. In the middle ground, CBM facilities generally would be subordinate or unnoticeable to the observer, especially with mitigation measures such as painting, feathering graded surfaces, and generally situating wells in areas that are screened by topography and vegetation. CBM-related facilities, with the exception of access roads, generally create very little visual contrast in background views.

### *Areas Classified as Retention*

Table 3–152 summarizes the area of surface disturbance by sensitive viewpoint, distance zone, and VQO. Approximately 211 acres of disturbance would occur in the foreground view of sensitive viewpoints in areas assigned the Retention VQO, under Alternative 1. Retention guidelines suggest that activities may only repeat the form, line, color, and texture that are frequently found in the characteristic landscape. The objectives of the Retention VQO would be met if mitigation measures were used to maintain the existing character of the landscape and not attract the attention of the casual observer. Mitigation measures must repeat the basic elements of form, line, color, and texture found in the natural features of the landscape within the foreground distance zone to achieve this objective. Successful mitigation in the foreground distance zone would include locating facilities to use the terrain and vegetation to screen them from sensitive viewing areas. The Retention objectives would not be met for facilities where these measures cannot be implemented. These facilities are most likely to be located on National Forest lands near residential areas, roads, and important recreational areas, because these areas would be within the viewshed of a relatively high number of people who are sensitive to changes in the landscape.

Approximately 283 acres of disturbance would occur in the middle ground view of sensitive viewpoints in areas assigned the Retention VQO under Alternative 1 (Table 3–152). Based on field observations, the impacts would be minimal from virtually all CBM-related development that would occur in the background view of sensitive viewpoints, because the facilities are too small to be visible at distances of more than 3 miles. Some CBM facilities would remain visually subordinate to the characteristic landscape where they are sited in the middle ground view of sensitive viewpoints in areas assigned the Retention VQO. Others, however, may result in changes to the landscape that is more noticeable. The Retention VQO would be met for most facilities in the middle ground view of sensitive viewpoints because mitigation measures would maintain the existing landscape, and facilities would not be evident to the casual viewer. Facilities that result in strong color contrasts between well pads and roads after mitigation with surrounding vegetation as seen from sensitive viewpoints would not meet the Retention VQO, because these contrasts are easily visible to the casual viewer.

### *Areas Classified as Partial Retention*

Approximately 168 acres of disturbance would occur in the foreground view of sensitive viewpoints in Partial Retention areas (Table 3–152). The VQO for facilities on Partial Retention lands would be met if adverse visual effects are minimized through careful location of facilities, minimal disturbance of the site, and painting of facilities so that they harmonize with the colors of the surrounding landscape. If the visual impacts cannot be mitigated through such measures, however, the Partial Retention VQO would not be met because the facilities would be visually evident to the observer and would not be subordinate to the characteristic landscape, as required to meet the VQO.

Approximately 264 acres of project-related disturbance would occur in the middle ground view of sensitive viewpoints in areas assigned the Partial Retention VQO under this alternative (Table 3–152). CBM facilities sited in the middle ground views in Partial Retention areas would be visually subordinate to the characteristic landscape or would be unnoticeable in the middle ground view. These visual impacts would be rated moderate to low, based on the observed effectiveness of visual-mitigation measures in reducing the severity of the visual contrast created by project facilities in middle ground views. The VQO for Partial Retention would be met for facilities located in middle ground views seen from sensitive viewpoints.

## Table 3–152 Distribution of Disturbance by Sensitive Viewpoint, Alternative, and Visual Quality Objective

| | Residential Areas[1] | | | Roads[1] | | | Recreation[1] | | |
|---|---|---|---|---|---|---|---|---|---|
| Alternative and VQO | Foreground[2] (acres) | Middle ground[2] (acres) | Background[2] (acres) | Foreground (acres) | Middle ground (acres) | Background (acres) | Foreground (acres) | Middle ground (acres) | Background (acres) |
| Alternative 1 | | | | | | | | | |
| Retention | 80 | 68 | 60 | 70 | 120 | 19 | 61 | 96 | 51 |
| Partial Retention | 28 | 52 | 132 | 15 | 157 | 41 | 125 | 56 | 32 |
| Modification | 3 | 1 | 247 | 22 | 174 | 55 | 127 | 105 | 19 |
| Alternative 1A | | | | | | | | | |
| Retention | 83 | 70 | 56 | 69 | 115 | 25 | 67 | 90 | 51 |
| Partial Retention | 30 | 46 | 113 | 15 | 130 | 43 | 99 | 59 | 30 |
| Modification | 2 | 0 | 219 | 20 | 157 | 43 | 116 | 87 | 18 |
| Alternative 1B | | | | | | | | | |
| Retention | 83 | 72 | 17 | 69 | 101 | 2 | 41 | 79 | 57 |
| Partial Retention | 30 | 45 | 75 | 12 | 109 | 28 | 76 | 49 | 25 |
| Modification | 2 | 0 | 151 | 10 | 105 | 39 | 98 | 48 | 7 |
| Alternative 2 | | | | | | | | | |
| Retention | 114 | 168 | 102 | 118 | 233 | 34 | 103 | 215 | 67 |
| Partial Retention | 38 | 154 | 273 | 37 | 377 | 52 | 272 | 139 | 56 |
| Modification | 1 | 15 | 292 | 27 | 223 | 57 | 163 | 128 | 17 |
| Alternative 3 | | | | | | | | | |
| Retention | 80 | 65 | 52 | 70 | 110 | 18 | 50 | 97 | 51 |
| Partial Retention | 28 | 39 | 65 | 11 | 88 | 32 | 44 | 56 | 32 |
| Modification | 3 | 1 | 132 | 13 | 88 | 36 | 18 | 99 | 19 |
| Alternative 4 | | | | | | | | | |
| Retention | 74 | 60 | 31 | 60 | 91 | 13 | 40 | 74 | 51 |
| Partial Retention | 28 | 47 | 105 | 10 | 138 | 30 | 99 | 56 | 25 |
| Modification | 2 | 7 | 119 | 10 | 90 | 27 | 65 | 58 | 5 |
| Alternative 5 | | | | | | | | | |
| Retention | 73 | 53 | 18 | 57 | 81 | 6 | 25 | 71 | 48 |
| Partial Retention | 21 | 19 | 12 | 2 | 37 | 13 | 12 | 19 | 20 |
| Modification | 2 | 0 | 47 | 0 | 36 | 13 | 6 | 42 | 2 |

Note:

1. Disturbance includes all wells, pads, roads, pipelines, disposal wells, and compressors on NFS, BLM, state, and private lands.
2. Foreground = 0.0 – 0.5 mile, Middle ground = 0.5 – 3.0 miles, Background = 3.0 miles – infinity

Based on field observations, the impacts on observers would be minimal from virtually all CBM-related development that would occur in the background view of sensitive viewpoints because the facilities are generally too small to be seen at distances of more than 3 miles. The VQO objectives for Partial Retention would be met for facilities located in background distance zones as viewed from sensitive viewpoints.

### *Areas Classified as Modification*

Nearly 752 acres of disturbance from proposed facilities would be on lands managed with the Modification VQO (Table 3–152). Under the Modification VQO, management activities may visually dominate the original characteristic landscape. However, alterations to vegetation and land form must borrow from naturally established form, line, color, or texture so completely and at such a scale that its visual characteristics are those of natural occurrences within the surrounding area or character type. NFS objectives for facilities on Modification lands would be met if every attempt were made to minimize adverse visual effects through careful location of facilities, minimal disturbance of the site, and painting facilities so they harmonize with the colors of the surrounding landscape. The Modification VQO would be met in all distance zones, because mitigation would borrow from the surrounding natural landscape.

### *3.14.3.1.2 Alternative 1A*

Table 3–151 summarizes the acreages that would be affected by Alternative 1A in each VQO classification area. Table 3–152 identifies the distribution of visual impacts by sensitive viewpoint, distance zone, and VQO for this alternative.

Alternative 1A would have much the same types of environmental effects as described for Alternative 1, but differs in terms of the extent of effects on NFS land. On the SJNF, Alternative 1A would utilize 231 facilities, which is less than the 294 facilities proposed for Alternative 1. There would be 94 miles of access roads, which is about 25 percent less than is proposed for Alternative 1. Long-term disturbance within the Project Area would be 617 acres from all facilities under Alternative 1A, which is slightly less than the 672 acres impacted by Alternative 1 (Table 3–151).

As a result, the long-term disturbance of NFS land in each VQO class is expected to be less than for Alternative 1, because fewer well pad locations would be impacted and fewer miles of road would be constructed. Doubling up wells on a single pad in Alternative 1A is an effective form of visual-impact mitigation. The Retention VQO for facilities on NFS lands would not be met for those facilities where mitigation does not effectively maintain the existing character of the landscape so that facilities do not attract the attention of the casual observer. There would be slightly more disturbance from facilities in the foreground of views from sensitive areas in the Retention VQO than in Alternative 1 (Table 3–152). Consequently, it is likely that a greater number of facilities would not meet the Retention VQO. The Partial Retention VQO would not be met for facilities that would be visually evident to the observer and would not be subordinate to the characteristic landscape once mitigation has been implemented. Facilities in the middle ground and background views would meet the Partial Retention VQO with implementation of mitigation measures. A smaller number of facilities under this alternative would not be able to meet the Partial Retention VQO than under Alternative 1, as less disturbance results from Alternative 1A. The objectives for the Modification VQO would be met for facilities in all distances zones with the implementation of mitigation.

### 3.14.3.1.3 Alternative 1B

Table 3–151 summarizes acreages that would be affected by Alternative 1B in each VQO classification area. Table 3–152 identifies the distribution of visual impacts by sensitive viewpoint, distance zone, and VQO for this alternative.

Alternative 1B includes the same types of environmental effects described for Alternative 1, but also differs in terms of magnitude of effect on NFS land. Alternative 1B would utilize 172 facilities, considerably less than the 294 facilities proposed for Alternative 1. There would be 62 miles of access roads, which is about 47 percent less than is proposed for Alternative 1. Long-term disturbance would equal about 484 acres from all CBM facilities under Alternative 1B (Table 2–3), which is 40 percent less than the 684 acres impacted by Alternative 1 (Table 2–1). As a result, the long-term disturbance of NFS land in each VQO class is expected to be less than under Alternative 1.

The Retention VQO for facilities on FS lands would not be met where mitigation does not effectively maintain the existing character of the landscape so that the facilities do not attract the attention of the casual observer. There is slightly less disturbance from facilities in the foreground of views from sensitive areas than in Alternative 1, so it is likely that a smaller number of facilities would not meet the Retention VQO. Partial Retention objectives would not be met for facilities that would be visually evident to the observer and would not be subordinate to the characteristic landscape once mitigation measures have been implemented. Facilities in the middle ground and background views would meet Partial Retention objectives with implementation of mitigation measures. Fewer facilities under this alternative would not be able to meet Partial Retention objectives than under Alternative 1. The objectives for the Modification VQO would be met for facilities in all distances zones with mitigation measures.

Visual impacts on private, state, and BLM land would be the same as described for Alternative 1.

### 3.14.3.1.4 Alternative 2

Alternative 2 would entail more intensive CBM development than Alternative 1 —particularly near the Fruitland outcrop and on the eastern side of the Project Area. Alternative 2 would involve constructing 521 CBM facilities on federal, state, and private lands. In addition, Alternative 2 would require 204 miles of road construction, approximately twice the miles proposed for Alternative 1. The additional wells and roads constructed under Alternative 2 would contribute to a significant increase in visual impacts across the Project Area.

Table 3–151 summarizes acreages that would be affected by Alternative 2 in each VQO classification area. Table 3–152 identifies the distribution of visual impacts by sensitive viewpoint, distance zone, and VQO for this alternative.

About 334 acres of disturbance would occur in the foreground view of sensitive viewpoints assigned the Retention VQO, and almost 350 acres of disturbance would occur in the foreground of sensitive viewpoints assigned the Partial Retention VQO (Table 3–152). Furthermore, approximately 616 acres of disturbance would occur in the middle ground view of sensitive viewpoints in areas assigned the Retention VQO, and 670 acres of disturbance would occur in the middle ground view of sensitive viewpoints in areas assigned the Partial Retention VQO under this alternative (Table 3–152). Most visual impact would occur in these area classifications.

Nearly 55 percent of the CBM facilities would be on NFS land, the majority of which would be on land managed with Retention and Partial Retention VQOs. There is considerably more disturbance from facilities in the foreground of views from sensitive areas than in Alternative 1, so it is likely that a greater number of facilities would not meet the Retention VQO. Similarly, a larger number of facilities under this alternative would not be able to meet the Partial Retention objectives than under Alternative 1, as more disturbance is proposed for Alternative 2. The objectives for the Modification VQO would be met for facilities in all distances zones with implementation of mitigation measures.

#### *3.14.3.1.5 Alternative 3*

Alternative 3 would preclude CBM development in the HD Mountains Inventoried Roadless Area but would result in the same CBM development in the rest of the Project Area as was described for Alternative 1. There would be 226 CBM facilities and 78 miles of road located on federal, state, and private land, resulting in a smaller number of facilities that affect the visual quality of the Project Area, particularly in the HD Mountains.

No proposed facilities are within the HD Mountains Inventoried Roadless Area. Therefore, a significant portion (more than 20,000 acres) of the National Forest portion of the Project Area would remain undeveloped and not visually impacted by CBM development.

Table 3–151 summarizes acreages that would be affected by Alternative 3 in each VQO classification area. Table 3–152 identifies the distribution of visual impacts by sensitive viewpoint, distance zone, and VQO. Alternative 3 would impact the foreground and middle ground views of sensitive viewpoints in the Retention and Partial Retention VQOs less than would Alternatives 1, 1A, and 1B. About 200 acres of disturbance would occur in the foreground view of sensitive viewpoints assigned the Retention VQO, and 83 acres of disturbance would occur in the foreground view of sensitive viewpoints assigned the Partial Retention VQO (Table 3–152). In addition, about 271 acres of disturbance would occur in the middle ground view of sensitive viewpoints in areas assigned the Retention VQO; 183 acres of disturbance would occur in the middle ground view of sensitive viewpoints in areas assigned the Partial Retention VQO under this alternative (Table 3–152).

The long-term disturbance of NFS land in each VQO class is expected to be less than for Alternative 1 because there would be a smaller number of well pads, compressors, and miles of road constructed on NFS land. There is slightly less disturbance from facilities in the foreground of views from sensitive areas than in

Alternative 1, so it is likely that a smaller number of facilities would not meet the Retention VQO. Facilities in the middle ground and background views would meet Partial Retention objectives with implementation of mitigation measures. A smaller number of facilities under this alternative would not be able to meet Partial Retention objectives than under Alternative 1, because fewer facilities are proposed for Alternative 3. The objectives for the Modification VQO would be met for facilities in all distances zones with implementation of mitigation measures.

### *3.14.3.1.6 Alternative 4*

Alternative 4 would result in construction of 193 CBM facilities and 91 miles of road located on federal, state, and private land, resulting in a smaller number of facilities that affect the visual quality of the Project Area than under Alternative 1 Generally, visual impacts would be lower than under Alternative 1 on National Forest System land and the same as Alternative 1 on all other jurisdictions.

Table 3–151 summarizes acreages that would be affected by Alternative 4 in each VQO classification area. Table 3–152 identifies the distribution of visual impacts by sensitive viewpoint, distance zone, and VQO for this alternative. Alternative 4 would disturb the foreground and middle ground views of sensitive viewpoints in the Retention and Partial Retention VQOs less than would Alternative 1. About 173 acres of disturbance would occur in the foreground view of sensitive viewpoints assigned the Retention VQO, and 137 acres of disturbance would occur in the foreground view of sensitive viewpoints assigned the Partial Retention VQO (Table 3–152). Similarly, approximately 225 acres of disturbance would occur in the middle ground view of sensitive viewpoints in areas assigned the Retention VQO, and 241 acres of disturbance would occur in the middle ground view of sensitive viewpoints in areas assigned the Partial Retention VQO under this alternative (Table 3–152).

The long-term disturbance of NFS land in each VQO class is expected to be less than for Alternative 1, because there would be a smaller number of CBM facilities and miles of road constructed on NFS land. The Retention objectives for facilities on FS lands would not be met where mitigation measures do not effectively maintain the existing character of the landscape so that facilities do not attract the attention of the casual observer. There is less disturbance from facilities in the foreground of views from sensitive areas than in Alternative 1, so it is likely that a smaller number of facilities would not meet the Retention VQO. Partial Retention objectives would not be met for facilities that would be visually evident to the observer and would not be subordinate to the characteristic landscape once mitigation measures have been implemented. Facilities in the middle ground and background views would meet Partial Retention objectives with implementation of mitigation measures. A smaller number of facilities under this alternative would not be able to meet Partial Retention objectives than under Alternative 1, as less disturbance is proposed for Alternative 4. The objectives for the Modification VQO would be met for facilities in all distances zones with implementation of mitigation measures.

#### 3.14.3.1.7 Alternative 5 — No Action

Alternative 5 would result in construction of 123 CBM facilities and 39 miles of road located on federal, state, and private land, resulting in a smaller number of facilities that affect the visual quality of the Project Area than under Alternative 1. Visual impacts would be lower than under Alternative 1 on NFS and BLM lands, the same on state land, and slightly higher on private land. Alternative 5 would have the least visual impact on federal land among the alternatives. Visual impacts on state and private land would be similar to the effects described for Alternative 1.

Table 3–151 summarizes acreages that would be affected by Alternative 5 in each VQO classification area. Table 3–152 identifies the distribution of visual impacts by sensitive viewpoint, distance zone, and VQO for this alternative.

Alternative 5 would have the least impact among the alternatives on the foreground and middle ground views of sensitive viewpoints in the Retention and Partial Retention VQOs. There would be about 154 acres of disturbance in the foreground view of sensitive viewpoints assigned the Retention VQO and 35 acres of disturbance in the foreground view of sensitive viewpoints assigned the Partial Retention VQO (Table 3–152). Similarly, about 206 acres of disturbance would occur in the middle ground view of sensitive viewpoints in areas assigned the Retention VQO and 75 acres of disturbance in the middle ground view of sensitive viewpoints in areas assigned the Partial Retention VQO under this alternative (Table 3–152).

The long-term disturbance of NFS land in each VQO class is expected to be less than Alternative 1, because there would be a smaller number of CBM facilities and miles of road constructed on NFS land. There is considerably less disturbance from facilities in the foreground of views from sensitive areas than in Alternative 1, so it is likely that a smaller number of facilities would not meet the Retention VQO. Facilities in the middle ground and background views would meet Partial Retention objectives with implementation of mitigation measures. A smaller number of facilities under this alternative would not be able to meet Partial Retention objectives than under Alternative 1, as less disturbance is proposed for Alternative 4. The objectives for the Modification VQO would be met for facilities in all distances zones with implementation of mitigation measures.

### 3.14.3.2 Sensitivity to Flaring and Compressor Lighting

#### 3.14.3.2.1 Alternative 1 — Proposed Action

A typical CBM well is initially flared for 3 to 5 days. During this time, a large orange flame as tall as 20 feet burns continuously, day and night. During daylight, flaring is prominent only in the foreground distance zone. In the middle ground and background, flaring creates a low visual contrast and in most cases is barely perceptible. However, flaring can have a much greater visual impact during nighttime. Without topographic or vegetative screening, it can be visible for miles at night, which can create a moderate to high visual contrast in the foreground, middle ground, and sometimes background views. This visual impact would be even more pronounced on overcast nights. This analysis estimated that, at most, one to two wells would be flaring at any one time in the Project Area.

Nighttime lighting of compressor stations also would result in increased viewshed sensitivity. Permanent yard lighting has historically been installed for safety and security. This lighting typically consists of low-pressure sodium vapor fixtures arranged around the site so that the equipment can be safely operated during darkness.

Of the six existing compressors considered in this analysis, five are in the western portion of the Project Area, where most of the residential development has occurred. Fourteen more compressor sites are proposed in the Project Area. Lighting from these facilities may not draw the attention of casual observers, based on the level of residential development in this portion of the Project Area.

Additional compressors in the eastern portion of the Project Area would have more visual impact associated with night lighting, because of the contrast against the relatively dark night sky in this undeveloped area. The increased contrast would draw the attention of the casual observer during the nighttime. This incremental increase would result in noticeable impacts on the eastern portion of the Project Area, but fewer viewers would be affected by the increase in this part of the area.

### 3.14.3.2.2 Alternative 1A

This analysis estimated that fewer than three wells would flare at any one time in the Project Area, because the number of wells that would be developed would be smaller than was described for Alternative 1. Residents and recreational visitors in the Project Area would experience minor visual impacts during daylight, but would observe orange flames or glows in the evening from miles away, where wells are not screened by topography or vegetation. This effect would be particularly pronounced when the sky is overcast.

Nighttime lighting of compressor stations also results in decreased viewshed sensitivity, compared with Alternative 1. The positioning of the lights would be the same as in Alternative 1. Based on the level of residential development in this portion of the Project Area, lighting from these facilities may not draw the attention of casual observers. Fourteen compressors would be added to the Project Area; as a result, the number of viewers that would be affected would be the same as for Alternative 1.

### 3.14.3.2.3 Alternative 1B

This analysis estimated that fewer than three wells would flare at any one time in the Project Area, because the number of wells that would be developed would be less than for Alternative 1. Residents and recreational visitors in the Project Area would experience minor visual impacts during daylight, but would observe orange flames or glows in the evening from miles away, where wells are not screened by topography or vegetation.

Nighttime lighting of compressor stations also results in decreased viewshed sensitivity, compared with Alternative 1. The positioning of the lights would be the same as in Alternative 1. Based on the level of residential development in this portion of the Project Area, lighting from these facilities may not draw the attention of casual observers. Seven compressors would be added to the Project Area, which would affect a slightly smaller number than the 14 compressors proposed for Alternative 1.

#### *3.14.3.2.4 Alternative 2*

A larger number of wells would be flaring at any one time in the Project Area, compared with Alternative 1. Residents and recreational visitors in the Project Area would experience minor visual impacts during daylight but would observe orange flames or glows in the evening from miles away, where wells are not screened by topography or vegetation. This effect would be particularly pronounced when the sky is overcast.

More compressors would be in the eastern portion of the Project Area, compared with Alternative 1, which would increase visual sensitivity because of the lighting against dark the night sky in a rural, undeveloped area. This contrast would draw the attention of the casual observer during the nighttime.

#### *3.14.3.2.5 Alternative 3*

The HD Mountains Inventoried Roadless Area would not be developed as a result of this alternative; therefore, visual impacts associated with flaring and night lighting would not occur in this area. Visual impacts in the rest of the Project Area would be the same as for Alternative 1.

#### *3.14.3.2.6 Alternative 4*

Fewer than three wells would flare at any one time in the Project Area, because the number of wells that would be developed would be less than in Alternative 1. Nighttime impacts would be the same as described for Alternative 1.

Nighttime lighting of compressor stations would also result in decreased viewshed sensitivity, compared with Alternative 1. The positioning of the lights would be the same as in Alternative 1. Based on the level of residential development in this portion of the Project Area, lighting from these facilities may not draw the attention of casual observers. The number of compressors that would be added to the Project Area would be reduced to six; as a result, fewer viewers would be affected when compared to Alternative 1.

#### *3.14.3.2.7 Alternative 5 — No Action*

Fewer than three wells would flare at any one time in the Project Area. Nighttime impacts in the western side of the Project Area would be the same as were described for Alternative 1. Flaring impacts would be very low in the eastern side of the Project Area, because of the limited amount of development occurring under Alternative 5.

There would be five new compressors under this alternative, the least of all alternatives. Nighttime lighting of compressor stations would be the same as described for Alternative 1 in the western side of the project area, but of no impact on the east side, SJNF portion of the Project Area.

## 3.14.4 Cumulative Impacts

The cumulative-impacts analysis includes: (1) existing conventional and CBM wells in the SUIT Project Area; (2) conventional and CBM wells projected and approved in the SUIT EIS; and (3) existing and proposed wells and ancillary facilities for each proposed development alternative within the Project Area.

When the existing and proposed oil and gas development are considered together, overall disturbance would increase from 50 to 236 percent from existing development for the alternatives (Table 3–153). Most of this total disturbance would occur in areas classified with the Retention VQO under each alternative. Disturbance in areas classified with Partial Retention VQO and Modification VQO would account for the remainder of disturbance from project facilities and roads.

**Table 3–153 Distribution of Existing and Proposed Oil and Gas Development Disturbance in the Project Area by Visual Quality Objective**

| | Disturbance[1] by Alternative | | | | | | |
|---|---|---|---|---|---|---|---|
| Visual Quality Objective | 1 (acres) | 1A (acres) | 1B (acres) | 2 (acres) | 3 (acres) | 4 (acres) | 5 (acres) |
| Retention | 562 | 562 | 525 | 738 | 551 | 518 | 497 |
| Partial Retention | 327 | 303 | 265 | 581 | 246 | 294 | 167 |
| Modification | 272 | 242 | 175 | 329 | 158 | 149 | 71 |
| Total | 1,162 | 1,108 | 965 | 1,649 | 956 | 962 | 735 |
| Increase over existing | 137% | 126% | 97% | 236% | 95% | 96% | 50% |

Note:

1. Includes all wells, pads, roads, pipelines, disposal wells, and compressors on NFS, BLM, State, and private lands
2. Does not include one compressor and one injection well totaling 3.5 acres of disturbance located outside of the Project Area boundary. These facilities are not within the area inventoried with VQO classes.

None of the SUIT land was inventoried or analyzed with the FS VMS system. Therefore, the cumulative acres presented in Table 3–154 include the number of acres within each distance zone as viewed from the primary sensitive viewpoints of residences, roads, and recreational areas. The cumulative disturbance acres were presented in this format in the SUIT FEIS. The long-term disturbance from oil and gas development is shown for the SUIT project and from existing development in the second and third columns of the table. The columns under the heading Disturbance by Alternative show the cumulative long-term disturbance from the SUIT acres, existing disturbance in the Project Area, and projected disturbance from each alternative. Alternative 2 would account for the largest amount of disturbance in the foreground distance zones. The SUIT acres account for the majority of cumulative disturbance under any of the alternatives.

Another trend that will increase the magnitude of visual-quality impacts and conflicts is projected growth in La Plata County. It is anticipated that growth will occur along U.S. 160 and near many of the county roads north of U.S. 160. As residential development increases, CBM well operators will be further challenged to meet the criteria for the Partial Retention and Retention VQOs. The number of mitigation measures that can be applied to each well is limited. Furthermore, in some instances, viewers (primarily permanent residents on private land) will be affected by CBM development regardless of the level of mitigation involved.

**Table 3–154 Distribution of Cumulative Oil and Gas Development Disturbance by Distance Zone**

| Sensitive Viewing Area/Distance Zone | SUIT Cumulative (acres) | Existing (acres) | Disturbance[1] by Alternative 1 (acres) | 1A (acres) | 1B (acres) | 2 (acres) | 3 (acres) | 4 (acres) | 5 (acres) |
|---|---|---|---|---|---|---|---|---|---|
| Residences | | | | | | | | | |
| Foreground | 4,853 | 169 | 5,134 | 5,137 | 5,137 | 5,176 | 5,176 | 5,216 | 5,118 |
| Middle ground | 5,194 | 124 | 5,439 | 5,434 | 5,436 | 5,655 | 5,423 | 5,431 | 5,390 |
| Background | 12,976 | 23 | 13,438 | 13,386 | 13,242 | 13,667 | 13,249 | 13,255 | 13,077 |
| Roads | | | | | | | | | |
| Foreground | 2,243 | 105 | 2,455 | 2,452 | 2,439 | 2,530 | 2,442 | 2,429 | 2,407 |
| Middle ground | 3,596 | 199 | 4,245 | 4,197 | 4,110 | 4,629 | 4,081 | 4,115 | 3,950 |
| Background | 17,235 | 12 | 17,361 | 17,358 | 17,315 | 17,390 | 17,332 | 17,318 | 17,278 |
| Recreation | | | | | | | | | |
| Foreground | 225 | 54 | 592 | 561 | 493 | 816 | 391 | 482 | 321 |
| Middle ground | 242 | 140 | 638 | 617 | 558 | 862 | 633 | 569 | 569 |
| Background | 19,222 | 123 | 19,447 | 19,444 | 19,428 | 19,485 | 19,447 | 19,426 | 19,426 |

Note:

1. Includes all existing and proposed wells, pads, roads, pipelines, disposal wells, and compressors on NFS, BLM, state, and private land in the Project Area, and all cumulative tribal and non-tribal disturbance acreage within the SUIT Study Area.
2. Disturbance acres from residential road and recreation viewing areas overlap; therefore, the areas do not add up to disturbance area totals presented in Chapter 2.

## 3.14.5 Mitigation and Monitoring

There are two approaches to visual mitigation. First, the site can be strategically situated so that the visual impacts are minimized and the likelihood is reduced that the site would attract attention. Examples of this type of visual mitigation include placing facilities at the base of slopes, instead of on ridges, and designing roads to follow the contours of the land. The design of the facility, the adjacent land uses, and the visual observation points control the level of sensitivity and the number of viewers affected. Careful selection of sites during the siting process can ultimately decrease the level of buffering and landscaping that would be required, so that the site is less likely to attract attention from a casual observer (in other words, sensitivity is decreased). Use of topography and natural vegetation can decrease the costs of visual mitigation for the operator. More important, this approach represents the best mitigation measure possible, because it involves more limited alteration of the natural landscape.

Second, construction and operation at a location can be visually mitigated using specific post-construction and -operation measures that decrease the number of viewers and, thus, the likelihood that the site would attract attention. This approach can be used in addition to siting mitigation, or when siting mitigation is unfeasible. Examples of this type of mitigation include painting facilities in non-reflective natural colors that blend with adjacent vegetation or geologic features, and feathering and rounding the edges of the well pad surface, to reduce obvious contrasts with the natural landform.

The combination of measures used to mitigate any one impact may vary considerably, depending on the nature of the impact and the viewing conditions. The techniques described in this section should be implemented as needed during design of all facilities.

Some of the mitigation measures included in this section may conflict with the measures proposed for other resources. For example, mitigating the straight-line effects created by pipeline corridors includes clearing additional vegetation, in an attempt to blend the pipeline with natural features. Clearing may, however, have undesirable impacts on vegetation communities and wildlife habitat in some areas. Conflicts of this nature should receive special attention before any measures are implemented.

Table 3–155 identifies mitigation measures that would reduce or help minimize the potential visual impacts. Unless otherwise stated, the following measures will be funded by the Companies. These measures include:

(1) Wet down and compact roads, where needed, to avoid generating dust and soil loss.

(2) Recontour unused portions of the drill pad reseed per BLM requirements.

(3) Recontour all disturbed areas to blend as nearly as possible with the natural topography. Remove all berms and refill all cuts. Rip all compacted portions of the pad to a depth of 12 inches, unless they are located in solid rock.

(4) Paint all permanent structures (on site for 6 months or longer) in a flat, non-reflective, earth tone color.

Reclamation would be considered successful only when the desired vegetative species are established, erosion is controlled, weeds are considered a minimal threat, and it is likely that ground cover will return to a desirable condition. The operator would continue revegetation efforts until this standard is met.

## 3.14.6 Conformance to Existing Plans and Policies

### 3.14.6.1 Conformance with Forest Service Land Use Plans

The amended LRMP for the SJNF (1992) establishes general long-range direction for managing visual resources and sets forth more specific long-range direction, based on Management Areas.

The VQOs on NFS land for the Project Area are Retention, Partial Retention, and Modification. The objective of Partial Retention is assigned to the majority of NFS land, followed by Modification (Table 3–149, page 3–363). Depending on the alternative chosen, 28 to 200 new gas wells could be constructed within the Partial Retention zone of the Project Area and between 13 and 112 wells would be drilled in the Modification area. Development in these areas could conform to the designated VQO, as well as the LRMP, if mitigation is implemented during construction and during the on-site monitoring phase. Depending on well site densities and sight distances within a particular area, however, the cumulative effect may exceed the VQO in those areas.

**Table 3–155 Potential Effects and Recommended Mitigation**

| Potential Effect | Recommended Mitigation |
|---|---|
| Degradation of the visual setting because of the contrast between exposed soils and surrounding vegetated areas. | Use existing vegetation and topographic features to screen wells, facilities, and roads.<br>Require vigorous, self-sustaining vegetation (that does not burn off after grazing) as a reclamation measure. |
| Degradation of the visual setting because of high visibility of well development facilities. | All development components will meet agency guidelines for color as specified in the COA. Colors will be of natural earth tones that match surrounding summer vegetation or rocks. The Forest Service will approve colors. |
| Strong contrast between new construction and surrounding vegetated areas. | Landscaping will blend the site developments into the surrounding landscape. Native tree, shrub, and grass species will be employed in landscaping.<br>Minimize the height of the pumping unit where possible, use vegetative and topographic screening when siting well locations, design well pad and facilities with scalloped edges in wooded areas, avoid high wall cuts, and shield lights from the drilling rig. |
| Clearing of vegetation for pipeline installation, creating prominent linear features in the landscape. | Removal of vegetation may be necessary for pipeline installation, unless the pipeline is to follow the alignment of the access road. Where possible, the area will be cleared in a non-linear fashion to blend the clearing with the surrounding vegetation. Native tree, shrub, and grass species will be employed in revegetation. Employ vegetative edge feathering in sloped areas that are fully visible from sensitive areas, such as roads, use areas, and residences. |
| Construction of new well pads access roads, creating prominent linear features in the landscape. | Avoid straight line-of-sight road construction and design roads through wooded areas to follow a curvilinear path. All road designs would consider the requirements of the anticipated vehicles, including travel way, width, grade, curve radius, sight distance, and design speed. Avoid road construction across ridge tops where it may cause a contrast in the landscape or add skyline alterations that would call attention to their addition.<br>Avoid road construction across ridge tops. |
| Deterioration of the night dark sky scenic values due to security lighting | Install light sensitive, motion activated lighting systems that are illuminated only when needed for security maintenance. |

An estimated 60 to 75 wells are proposed in the Retention zone that are in the foreground viewing-distance zone (up to 0.5 mile from the observer), depending on the alternative considered. The existing gas wells in the foreground viewing-distance zone generally do not meet the Retention VQO, because of their visibility and prominence. It is unlikely, therefore, that the VQO will be met in the foreground for the proposal. Although mitigation measures would lessen the visual impact, the nature of the gas well facilities makes it difficult, if not impossible, to blend into the characteristic landscape in a way that is not obvious to anyone viewing them within this close range.

The proposed new gas wells within the middle ground and background distance zones may meet the Retention VQO if the mitigation measures are adopted during the design and siting phases and are enforced during the monitoring phase.

Considering the total area, the potential for major visual disruption would not be from the gas well facilities but from the network of access roads associated with the proposal. The linear alterations of the landscape that result from road construction would be moderately to highly visible from all distance zones.

### 3.14.6.2 Conformance with BLM Land-Use Plans

As previously discussed, the FS inventory was expanded to include BLM land as well as private and state land, because BLM land in the Project Area had not been inventoried with the VRM and this approach was deemed advisable to maintain consistency in the analysis of visual resource management. For this analysis, conformance with the BLM RMP can be assessed assuming that the BLM Class II Objective approximates the FS Retention VQO, BLM Class III Objective approximates the FS Partial Retention VQO, and BLM Class IV Objective approximates the FS Modification VQO. Based on these assumptions, most of the BLM land within this Project Area is assigned Class II and III objectives, and small portions are assigned Class IV.

As discussed in the previous section, proposed gas wells developed in the Retention VQO (Class II Objective) would probably not meet that objective in the foreground distance zone, particularly if they are completed in the visual vicinity of existing gas wells. The cumulative effect of the existing and proposed development would most likely not conform to the requirements of this objective. New gas well development in the middle-ground and background distance zones, as well as those in the Class III and Class IV objective areas, could meet the visual objectives if it incorporates mitigation measures during siting and construction. Still, these visual objectives may not be met, because of the cumulative effects of the existing and proposed development, combined. In addition, the linear effect of the road system would alter the character of the landscape, as the roads are likely to attract the attention of the viewer with the visual contrast in color, form, line, and texture, as well as the activities associated with the road corridors.

## 3.14.7 Unavoidable Adverse Effects

Unavoidable adverse effects would occur under each of the alternatives. The types of impacts would be the same for each alternative. The primary difference among alternatives is the number of CBM facilities located within the foreground and middle ground of views from residential areas, roads, and recreation areas. The extent of unavoidable adverse impacts would be greatest under Alternative 2, followed by Alternatives 1, 1A, 1B, 3, 4, and 5. The visual quality of the Project Area landscape would be degraded for the viewing areas where wells are sited within foreground and middle ground zones. The objectives for some wells on NFS lands managed in the Retention, Partial Retention, and Modification VQO areas would not be met under any of the alternatives if mitigation measures do not enable facilities to blend with the landscape. Adverse effects to the visual quality of the HD Mountains landscape would occur under all alternatives, with the exception of Alternative 3, which would not develop facilities in the HD Mountains.

## 3.14.8 Irreversible and Irretrievable Effects

No irreversible effects would occur to visual resources. Post-project reclamation would return affected landscapes to a condition approximating pre-project conditions.

Irretrievable effects that would occur for the life of the project would be the addition of an industrial element to rural or natural landscapes.

# 3.15 Noise

## 3.15.1 Issues

This section discusses noise impacts that could result from further CBM development in the Project Area. The impacts of noise on wildlife are addressed in the *Wildlife* section of this chapter. The effects of noise on property values are addressed in the *Social and Economics* section. The following are noise issues raised during the scoping process.

*Issue 11: The effect of additional CBM development on area noise.*

- What are the day and nighttime noise levels associated with construction, drilling, and operation of CBM facilities?
- Does noise from CBM development and operation affect property values?
- Does noise from CBM development and operation affect wildlife?
- Are there intrusive vibrations, especially from cavitation and fracturing operations, that affect sensitive receptors (SR's) such as outdoor living space around residences?

## 3.15.2 Affected Environment

Noise is unwanted sound. Discussions of environmental noise do not focus on pure tones because the frequency and pressure characteristics of commonly heard sounds are complex. Accordingly, sound-measurement equipment has been designed to account for the sensitivity of human hearing to different frequencies. Correction factors that adjust actual sound pressure to correspond with human hearing have been established experimentally. A-weighted correction factors are employed for measuring human-perceived noise in ordinary environments. The filter de-emphasizes the very low and very high frequencies of sound in a manner similar to the response of the human ear. Therefore, the A-weighted decibel (dBA) is a good correlation to a human's subjective reaction to noise.

The dBA measurement is bases on a logarithmic scale of sound pressure. To the average human ear, the apparent increase in "loudness" doubles for every 10 dBA increase in noise (Bell 1982). Taking a baseline 60 dBA as the noise level experienced in normal conversation with two people standing 5 feet apart, noise of 50 dBA would be half as loud, and noise of 70 dBA would be twice as loud.

The EPA has established a level of 55 dBA as a guideline threshold for acceptable environmental noise (EPA 1974). This is used as a basis for evaluating effects from noise when no other local, county, or state standards have been established. The EPA guideline level was defined by scientific consensus without concern for economic and technological feasibility, and contained a margin of safety to ensure its protective value of the public health and welfare.

This guideline level is directed at areas where people would be exposed to an average noise level over a specific period. In this context, public health and welfare include personal comfort and well-being and the absence of mental anguish, disturbances, and annoyance, as well as the absence of clinical symptoms such as hearing loss or demonstrable physiological injury. Therefore, a 55 dBA guideline threshold is not a regulatory goal. Rather, 55 dBA should be recognized as a level below which there is no reason to suspect that the public health and welfare of the general population would be at risk from any of the effects of noise identified.

COGCC regulates noise from CBM facilities under its Aesthetic and Noise Control Regulation 802, Noise Abatement (COGCC 2004a). This regulation states that noise from operation of CBM facilities shall not exceed 55 dBA at residential areas from 7:00 A.M. to 7:00 P.M and shall not exceed 50 dBA from 7:00 P.M. to the following 7:00 A.M. However, higher noise levels are permitted for any operation that involves construction, drilling, completion, or workover of CBM facilities. Therefore, noise from construction and maintenance must not exceed 80 dBA from 7:00 A.M. to 7:00 P.M. and 75 dBA from 7:00 P.M to the following 7:00 A.M. Noise levels permitted for construction and maintenance may be increased by an additional 10 dBA for a period not to exceed 15 minutes in any hour from 7:00 A.M. to 7:00 P.M.

The COGCC noise regulation specifically applies to residential areas. However, COGCC Safety Regulation 600 (COGCC 2004b) established minimum setback distances from surface property lines or structures for wells and production facilities. Although this COGCC regulation is related to safety issues, it also serves as a *de facto* noise regulation because it provides for a buffer distance between surface property lines or structures and CBM facilities. Under the regulation, wells and associated production facilities shall be situated not less than 350 feet from any building unit, educational facility, assembly building, hospital, nursing home, board and care facility, or jail. These areas are collectively referred to as NSAs in this noise-impact analysis.

A review of the applicable planning documents (BLM 1984b, FS 1992) indicates there are no applicable noise standards within the Project Area. Therefore, the COGCC standards are considered as criteria to evaluate impacts from noise for this EIS.

### 3.15.2.1 Typical Noise Levels

The following discussion presents a reference of familiarity with common noise levels. These levels are intended to represent the average noise over a specified period (for example, a 24-hour interval or a yearly average) in various land-use areas. Depending on the location and the quantity and type of noise sources, these levels can vary widely, but are generally within 3 to 5 dBA (EPA 1974) above or below the "average" value. Table 3-156 shows examples of noise levels generated by commonly experienced sources in various land-use areas.

**Table 3-156 Typical Noise Levels**

| Noise Source | Average Noise (dBA) | Loudness[1] | Range of (dBA) |
|---|---|---|---|
| Ambulance siren (100 feet) | 100 | 16 times greater | 95-105 |
| Motorcycle (25 feet) | 90 | 8 times greater | 85-95 |
| Typical construction site | 85 | 6 times greater | 80-90 |
| Single truck (25 feet) | 80 | 4 times greater | 75-85 |
| Urban shopping center | 70 | 2 times greater | 65-75 |
| Single car (25 feet) | 65 | 1.5 times greater | 60-70 |
| Within 100 feet of a highway | 60 | 1 | 55-65 |
| Normal conversation (5 feet apart) | 60 | 1 | 57-63 |
| Residential area during day | 50 | 50% | 47-53 |
| Recreational area | 45 | 50% | 40-50 |
| Residential area at night | 40 | 25% | 37-43 |
| Rural area during day | 40 | 25% | 37-43 |
| Rural area at night | 35 | < 14% | 32-37 |
| Quiet whisper | 30 | < 12% | 27-33 |
| Threshold of hearing | 20 | < 6% | 17-23 |

Note:

1. Loudness based on 60 dBA, the noise level experienced in conversation between two people 5 feet apart

Sources: EPA 1974, Harris 1991

## 3.15.2.2 Existing CBM-Related Noise

Noise levels are elevated around CBM facilities. Noise is produced by vehicle and equipment usage, construction and drilling operations, small gas-fired engines, and operating pump jacks operating to extract the natural gas. This section describes the estimated noise levels near these facilities. The levels are intended to represent the noise expected at NSAs located away from these activities.

Noise is estimated using a level measured near the activity and then predicted at distances farther away, based on the Inverse Square Law of Noise Propagation, which states that noise will decrease (attenuate) by 6 dBA every time the distance from the source is doubled (Harris 1991). This methodology of estimating noise attenuation is represented by:

$$L_2 = L_1 - 20 \log (R_2/R_1)$$

where:

$L_2$ = noise level at a selected distance $R_2$ from the source

$L_1$ = noise level measured at a distance $R_1$ from the source.

## 3.15.2.3 CBM Construction

Noise impacts during the construction phase result from the operation of vehicles and construction equipment. Table 3-157 shows the approximate levels of noise experienced when standing 50 feet from various types of construction equipment. The table also shows how the noise decreases with distance from the equipment.

**Table 3-157 Levels of Noise Generated by Various Types of Construction Equipment**

| | Noise Level at: | | | | |
|---|---|---|---|---|---|
| Equipment Type | 50 Feet (dBA) | 500 feet (dBA) | 1,000 feet (dBA) | 1,500 feet (dBA) | 2,000 feet (dBA) |
| Crane | 88 | 68 | 62 | 58 | 56 |
| Backhoe | 85 | 65 | 59 | 55 | 53 |
| Pan Loader | 87 | 67 | 61 | 57 | 55 |
| Bulldozer | 89 | 69 | 63 | 59 | 57 |
| Fuel and Lubrication Truck | 88 | 68 | 62 | 58 | 56 |
| Water Truck | 88 | 68 | 62 | 58 | 56 |
| Motor Grader | 85 | 65 | 59 | 55 | 53 |
| Vibrator/Roller | 80 | 60 | 54 | 50 | 48 |
| Mechanic Truck | 88 | 68 | 62 | 58 | 56 |
| Flat Bed Truck | 88 | 68 | 62 | 58 | 56 |
| Dump Truck | 88 | 68 | 62 | 58 | 56 |
| Flat Bed Trailer | 88 | 68 | 62 | 58 | 56 |
| Tractor | 80 | 60 | 54 | 50 | 48 |
| Concrete Truck | 86 | 66 | 60 | 56 | 54 |
| Concrete Pump | 82 | 62 | 56 | 52 | 50 |
| Front End Loader | 83 | 63 | 57 | 53 | 51 |
| Road Scraper | 87 | 67 | 61 | 57 | 55 |
| Air Compressor | 82 | 62 | 56 | 52 | 50 |
| Average Construction Site | 85 | 65 | 59 | 55 | 53 |

Source: Crocker and Kessler 1982

Not all construction equipment operates continuously, so the average noise level during well pad construction is estimated to be 85 dBA. Using the propagation formulation, average noise levels decrease below 55 dBA about 1,700 feet from construction sites (Table 3-158). Any NSAs within 1,500 feet of construction, therefore, would experience temporary noise levels above 55 dBA during daylight hours. Nighttime noise levels are not usually affected, because construction typically occurs between 7:00 A.M. and 7:00 P.M.

Noise during the drilling phase would also be elevated above pre-existing levels. Typically, the noise from a drilling rig is 74 dBA at 200 feet (USGS 1981). Noise from drilling rigs would decrease from 60 dBA at 1,000 feet to 50 dBA at 3,000 feet (Table 3-158). These levels are experienced for 24 hours per day for the 8 days generally required to drill a CBM well. The noise impacts from drilling a water disposal well would be similar to a CBM wells, but would last longer because of its greater depth.

**Table 3-158 Noise Impacts from CBM Facilities**

| Distance from CBM Facility (feet) | Noise from Compressor Station with one engine (dBA) | Noise from Compressor Station with two engines (dBA) | Noise from Pump Jack (dBA) | Noise from drill Rig (dBA) | Noise from Construction (dBA) |
|---|---|---|---|---|---|
| 50 | 69.0 | 72.0 | 67.0 | 86.0 | 85.0 |
| 100 | 63.0 | 66.0 | 61.0 | 80.0 | 79.0 |
| 150 | 59.5 | 62.5 | 57.5 | 76.5 | 75.5 |
| 200 | 57.0 | 60.0 | 55.0 | 74.0 | 73.0 |
| 250 | 55.0 | 58.0 | 53.0 | 72.1 | 71.0 |
| 300 | 53.4 | 56.4 | 51.5 | 70.5 | 69.4 |
| 350 | 52.1 | 55.1 | 50.1 | 69.1 | 68.1 |
| 400 | 50.9 | 53.9 | 49.0 | 68.0 | 66.9 |
| 450 | 49.9 | 52.9 | 47.9 | 67.0 | 65.9 |
| 500 | 49.0 | 52.0 | 47.0 | 66.0 | 65.0 |
| 550 | 48.2 | 51.2 | 46.2 | 65.2 | 64.2 |
| 600 | 47.4 | 50.4 | 45.4 | 64.5 | 63.4 |
| 650 | 46.7 | 49.7 | 44.7 | 63.8 | 62.7 |
| 700 | 46.1 | 49.1 | 44.1 | 63.1 | 62.1 |
| 750 | 45.5 | 48.5 | 43.5 | 62.5 | 61.5 |
| 800 | 44.9 | 47.9 | 42.9 | 62.0 | 60.9 |
| 850 | 44.4 | 47.4 | 42.4 | 61.4 | 60.4 |
| 900 | 43.9 | 46.9 | 41.9 | 60.9 | 59.9 |
| 950 | 43.4 | 46.4 | 41.4 | 60.5 | 59.4 |
| 1,000 | 43.0 | 46.0 | 41.0 | 60.0 | 59.0 |
| 1,100 | 42.2 | 45.2 | 40.6 | 59.6 | 58.6 |
| 1,200 | 41.4 | 44.4 | 40.2 | 59.2 | 58.2 |
| 1,300 | 40.7 | 43.7 | ***39.8*** | 58.8 | 57.8 |
| 1,400 | 40.1 | 43.1 | 39.4 | 58.4 | 57.4 |
| 1,500 | 39.5 | 42.5 | 38.7 | 57.7 | 56.7 |
| 1,600 | 38.9 | 41.9 | 38.1 | 57.1 | 56.1 |
| 1,700 | 38.4 | 41.4 | 37.5 | 56.5 | 55.5 |
| 1,800 | 37.9 | 40.9 | 36.9 | 55.9 | 54.9 |
| 1,900 | 37.4 | 40.4 | 36.4 | 55.4 | 54.4 |
| 2,000 | 37.0 | 40.0 | 35.9 | 54.9 | 53.9 |
| 2,500 | 35.0 | 38.0 | 33.0 | 52.1 | 51.0 |
| 3,000 | 33.4 | 36.4 | 31.5 | 50.5 | 49.4 |
| 3,500 | 32.1 | 35.1 | 30.1 | 49.1 | 48.1 |

## 3.15.2.4 Operational Noise Levels

Noise levels would decrease substantially after the well pads, roads, and pipelines have been constructed and the wells have been drilled. Sources of operational noise would involve periodic vehicle trips to the well sites and the pump jacks. Typical noise from a pumping unit operating up to 24 hours per day is 61 dBA at 100 feet (USGS 1981). Noise from pump jacks would decrease to 55 dBA at 200 feet and 41 dBA at 1,000 feet (Table 3-158).

The noise from a pump jack is rhythmic, however, rather than the steady sound of smoothly running equipment. Therefore, although the noise level would be well below the 55-dBA significance threshold, it may be as noticeable as higher noise levels for some people.

Noise from one compressor engine enclosed in a building is about 89 dBA at 5 feet (USGS 1981). Noise from a compressor engine enclosed in a building typically is 69 dBA measured 50 feet from the edge of the building. If two compressor engines are operating, the noise is typically 3-dBA higher, or 72 dBA at 50 feet. Three compressor engines produce a noise of 74 dBA at 50 feet. Based on the noise attenuation equation, noise from compressor stations is below the

COGCC night-noise standard (50 dBA) at 450 feet for one compressor engine and 650 feet for two engines (Table 3-158). Noise from compressor stations with three engines would be below the COGCC night-noise standard at 770 feet. A noise level of 50 dBA would be audible inside residences with open windows during the night, however, because the typical background nighttime noise level in rural residential areas is 35 to 40 dBA.

#### 3.15.2.5 CBM Noise Complaints

Since June 1997, COGCC has investigated 44 complaints about noise generated by CBM operations in La Plata County, 12 within the Project Area and 32 outside the Project Area.

In the Project Area, two complaints involved compressor facilities, three involved well drilling, three resulted from truck noise, and four were about noise from operation of wells. Two of the 12 complaints resulted in a Notice of Violation, because the noise exceeded COGCC limits. The Notices of Violation involved operation of a compressor station in T35N R8W Section 36 and a pump jack in T35N R8W Section 24. Both of these complaints were filed and resolved in 1997. The operator of the compressor station installed walls around the compressor building, and the noise level decreased below the COGCC limit. An operator also installed a wall around the pump jack, and the noise decreased to acceptable limits. Investigations of the other complaints demonstrated that noise levels were below the COGCC limits.

Outside the Project Area, 21 of the 32 complaints involved compressor facilities. Notices of Violation were issued for six of these facilities, and the operators installed walls to decrease noise below COGCC limits. Investigation of the other complaints, which involved the operation and maintenance of wells, found that these operations produced noise at levels below the COGCC limits.

### 3.15.3 Environmental Consequences

#### 3.15.3.1 CBM Daytime and Nighttime Noise

The overall impact of noise is a function of the number of locations that are affected by noise from CBM related sources. This section describes the noise of individual CBM activities, as well as the total effect in a square mile (section) of development. Development under Alternative 2 (499 wells) would produce elevated noise levels in the Project Area at the largest number of locations; development under Alternative 5 (117 wells) would produce similar levels of noise but at the fewest locations.

##### *3.15.3.1.1 Alternative 1—Proposed Action*

Elevated noise levels would result from vehicles and operation of construction equipment during each phase of construction. Construction noise would be temporary, however, at each location. Well pad construction would last less than 36 days. Road construction would require about 7 days for each mile. The maximum noise level during CBM facility construction is assumed to be 85 dBA at 50 feet from the site. Using the noise attenuation equation described above, the levels would fall below the COGCC construction daytime limit of 80 dBA at 100 feet from construction areas. Because construction normally would occur between 7:00 A.M. and 7:00 P.M., nighttime noise levels would not be affected by construction. Compressor-station construction would require 1 to 2 months and would create the same type of impacts as site construction, but over a longer duration.

Noise generated during the construction and operational phases of the project would be similar to those described above for existing CBM-related noise. Noise during the drilling phase would exceed pre-existing levels (74 dBA at 200 feet from the rig). Additionally, it would ensue 24 hours a day for the 8 days that are generally needed to drill a CBM well. During the operational phase, sources of noise would then be limited to periodic vehicle trips to the well sites and the pump jacks. Noise emanating from pump jacks would range from 67 dBA at 50 feet from the well to 50 dBA at 375 feet (Table 3-158).

A Caterpillar model 3516 is typical of the engines that would be installed at compressor stations. Two sources make up the total noise from this engine. According to Caterpillar, the exhaust produces a noise of 109 dBA at 4.9 feet. The mechanical noise from the engine produces 99 dBA at 3.2 feet. To calculate the total noise from this engine, the two are combined, resulting in a total source noise of 109.4 dBA at 4.9 feet. The enclosed building where the compressor engine would operate would reduce noise by about 20 dBA (Cohn 1981). Therefore, the effective noise level would be 89.4 dBA at 5 feet from the edge of the building enclosure.

The noise emanating from the compressor would decrease to 55 dBA (the COGCC daytime limit) at 250 feet from the edge of the compressor building, and to 50 dBA (the COGCC nighttime limit) at 450 feet from the building. Table 3-158 shows the average noise levels that can be expected at increasing distances from CBM facilities. For example, the noise emanating from a two-engine compressor station would result in a level of 55 dBA at 350 feet from the edge of the compressor building and 50 dBA at 650 feet from the building.

This analysis suggests that the noise from any permanent CBM activity would be below 40 dBA, a typical average background noise at night, 2,000 feet from the facilities. If a two-engine compressor station were located at least 650 feet from NSAs, the COGCC regulatory noise standards would be met during both the day and night. The COGCC nighttime standard would also be met if the pump jacks would be 375 feet from any NSAs. Therefore, the COGCC safety regulations would preclude placement of any two engine compression facility within 375 feet of a NSA.

The impacts above describe the noise produced by a single compressor station or pump jack. The effect of multiple facilities must be considered, however, to calculate the total impact on noise from CBM activities.

CBM production would be widespread throughout the Project Area. A variety of locations could have a two engine compressor station and four wells at 160-acre spacing. Therefore, a similar scenario is developed to demonstrate the total noise effects of CBM facilities. The scenario, shown on Figure 3–73, considers a square mile with a compressor station in the center and four pump jacks centered in each quadrant of the square mile. In this example, the compressor building and the pump jacks are separated by 1,900 feet. For a graphical comparison of noise from a single source, compared with noise produced by multiple sources, the noise produced only by the two engine compressor station is also shown on Figure 3–73.

A grid was established to calculate predicted noise at each grid point spaced every 200 feet within this hypothetical square mile. We then calculated the noise from each source at every grid point, using the noise attenuation equation described previously. Similar to the effect of collocated sources, the total noise at a location produced by two or more sources is not a simple addition of the noise from multiple sources, but rather is a logarithmic summation.

The results of the noise modeling are shown in Figure 3–73. When the facilities are equally spaced, the 55-dBA and 50-dBA noise contours from the compressor station and the pumping facilities expand slightly in response to the contribution from the pump jacks. For example, the predicted distance where the noise level is 50 dBA from a two engine compressor station increases by 40 feet when the total effect of the pump jacks is considered. When the total noise from CBM facilities within a square mile is considered, the noise levels would be below the COGCC nighttime noise standard of 50 dBA in about 90 percent of the area. The noise would, however, be above 35 dBA, the average nighttime noise in a rural area, in nearly 80 percent of the area. Therefore, nighttime noise from CBM development would be audible within the same square mile of a two engine CBM compression station, and four pump jack engines, even in the absence of other sources, such as traffic near major roads or moderate to high wind.

Although noise levels near all CBM facilities would be similar, CBM development in the eastern portion of the Project Area would occur on NFS land more distant from populated areas and would not affect established NSAs. Noise from CBM development could affect NSAs in the western portion of the Project Area, however. Alternative 1 proposes 69 well locations or windows within or immediately adjacent to the existing and proposed subdivisions shown on Figure 3–41.

Noise could be an issue based on the proximity of NSAs within these subdivisions. Adherence to COGCC regulatory noise standards would preclude placement of wells within 350 feet of any NSAs identified within these areas. However, noise from the pump jacks could slightly exceed the 50 dBA nighttime COGCC limit within 375 feet of wells. Therefore, the minimum setback distance should be evaluated and possibly increased for any wells that would be located near NSAs.

### *3.15.3.1.2 Alternative 1A*

All of the drilling and subsequent production associated with short-reach horizontal drilling would take place on NFS land in the eastern portion of the Project Area. Although these wells could have associated small field compressors, given the minimal increase, and the lack of NSAs in this area, the noise effects of Alternative 1A would be similar to Alternative 1.

#### 3.15.3.1.3 Alternative 1B

All of the drilling and subsequent production associated with long-reach horizontal drilling would take place on NFS land in the eastern portion of the Project Area. Although overall noise level would be slightly less than under Alternative 1, because the sources of noise would be fewer and more dispersed, the noise effects of Alternative 1B would be similar to Alternative 1.

#### 3.15.3.1.4 Alternative 2

Similar to Alternative 1, CBM development in the eastern portion of the Project Area would occur on NFS land distant from populated areas and would not affect established NSAs. Noise from CBM development would affect NSAs in the western portion of the Project Area, with the levels of impact similar to Alternative 1.

Under Alternative 2, 95 well locations or windows are proposed in or immediately adjacent to the existing and proposed subdivisions shown on Figure 3–41. Noise could be an issue, based on the proximity of NSAs in these subdivisions. Adherence to COGCC regulatory noise standards would preclude placement of wells within 350 feet of any NSAs identified within these areas. However, noise from the pump jacks could slightly exceed the 50 dBA nighttime COGCC limit within 375 feet of wells. Therefore, the minimum setback distance should be evaluated and possibly increased for any wells that would be located near NSAs.

#### 3.15.3.1.5 Alternative 3

The impacts from noise associated with Alternative 3 would be identical to those identified in Alternative 1, since the lack of CBM activity in the HD Mountain Roadless Area would not affect the noise identified at and near other CBM activities throughout the Project Area.

#### 3.15.3.1.6 Alternative 4

Similar to Alternative 1, CBM development in the eastern portion of the Project Area would occur on NFS land distant from populated areas and would not affect established NSAs. Noise from CBM development would affect NSAs in the western portion of the Project Area, and would result in impacts similar to those of Alternative 1.

Under Alternative 4, 52 well locations or windows are proposed in or next to the existing and proposed subdivisions shown on Figure 3–41. Noise could be an issue, based on the proximity of NSAs within these subdivisions. Adherence to COGCC regulatory noise standards would preclude placement of wells within 350 feet of any NSAs identified within these areas. However, noise from pump jacks could slightly exceed the 50 dBA nighttime COGCC limit within 375 feet of wells. Therefore the minimum setback distance should be evaluated and possibly increased for any federal wells that would be located near NSAs.

#### 3.15.3.1.7 Alternative 5—No Action

CBM development in the eastern portion of the Project Area would not occur on NFS land or in the western part of the Project Area or on BLM mineral estate. Noise from private and State mineral estate development would affect NSAs in the western portion of the Project Area, with the level of impacts similar to Alternative 1.

Under Alternative 5, 52 well locations or windows are proposed in or immediately adjacent to the existing and proposed subdivisions shown on Figure 3–41. Adherence to COGCC regulatory noise standards would preclude placement of wells within 350 feet of any NSAs identified within these areas. However, noise from pump jacks could slightly exceed the 50 dBA nighttime COGCC limit within 375 feet of wells. Therefore the minimum setback distance should be evaluated and possibly increased for any federal wells that would be located near NSAs

### 3.15.3.2 Effect of Intrusive Vibrations from Cavitation and Fracturing Operations

We expect, based on industry response, that 100 percent of the CBM wells would be fractured in the eastern side of the Project Area. On the western side, the Companies would use fracturing at 75 percent of the wells and cavitation on up to 25 percent, to stimulate well production.

Noise and vibration are not expected to be significant under any of the alternatives, because of the depth of the completion methods. Short bursts of noise may be audible over the two-week period when cavitation would be employed. However, cavitation would be employed only during daylight hours from 7 a.m. to 7 p.m.

## 3.15.4 Cumulative Effects

The prominent sources of noise in and next to the Project Area are widespread oil and gas development; traffic, especially on Highway 160; residential areas; and occasional airplane traffic at the La Plata County Airport south of the Project Area. Additional noise sources in the Project Area are expected to occur with commercial and industrial development along Highway 160 east of the Florida River and near Bayfield.

As described above, the noise effect of individual CBM facilities is localized. Furthermore, since wells and compressor stations would be separated by sufficient distance, the cumulative effect of numerous facilities in a specific area would be limited. Compressor stations would have the highest potential to increase general localized noise, if located near other existing and future sources of noise. The pump jacks at each well pad would not produce sufficient noise to interact significantly with other sources to raise the overall noise within a localized area.

The CBM compressor stations may contribute to a slight cumulative increase in noise in the Project Area. Under all alternatives except Alternative 4, two compressor stations would be constructed near the proposed industrial and commercial development along Highway 160 east of the Florida River. The compressor stations and the industrial and commercial development would likely result in slightly higher overall noise in this area. Under all alternatives, two or three compressor stations would be constructed northeast of Bayfield near existing and proposed residential developments. The combination of increased residential activity and additional compressor stations would increase noise levels slightly here.

Since, no compressor stations are proposed for the Bayfield area, overall noise is not expected to increase significantly on a cumulative basis. All other compressor stations would be constructed at sufficient distances from existing and proposed noise sources so as not add significantly to the overall noise levels.

## 3.15.5 Mitigation and Monitoring

The following mitigation measures are recommended to reduce noise levels from CBM sources. Unless otherwise stated, the following measures will be funded by the Companies.

(1) Increase the distance between a CBM facility and an NSA. As shown in the analysis, noise decreases by 6 dBA with every doubling of distance from a source. For instance, if the noise were 55 dBA at 100 feet from a CBM source, the noise would decrease to 49 dBA at 200 feet from the source and to 43 dBA at 400 feet from the source.

(2) Enclose noise sources, including compressor stations. As shown in the impact analysis, closed buildings generally result in about a 20dBA attenuation of noise from compressor engines.

(3) Install noise mufflers and/or direct exhaust vents away from nearby NSAs. This procedure would reduce the noise directed toward a potentially affected NSA.

(4) Construct obstacles to noise in the direct path from the source of noise to a receiver. Such obstacles can be tightly spaced wood fences (no gaps in the wood panels), concrete fences, earth berms, or structures.

Barriers placed on CBM facility property boundaries aligned between the facility and the noise-sensitive receptors could achieve at least a 5-dBA reduction in noise level when they are tall enough to break the line of sight between the noise source and the receptor. An additional 1.5-dBA reduction can generally be achieved with each 3.5 feet of height after it breaks the line of sight.

## 3.15.6 Conformance to Existing Plans and Policies

Construction and operation of project facilities under all alternatives are expected to conform to existing federal plans and policies and COGCC's regulations. Where facilities do not meet standards identified in existing plans and policies outright, use of the mitigation measures identified above is expected to enable the Companies to construct and operate their facilities in conformance.

### 3.15.7 Unavoidable Adverse Effects

Implementation of any of the alternatives would result in an increase in local noise around project facilities in the Project Area. This increase in noise would be unavoidable.

### 3.15.8 Irreversible and Irretrievable Effects

Noise effects from CBM facilities would cease after the life of the project. Therefore, there would be no irreversible or irretrievable effects of noise.

# 3.16 Social and Economic Values

## 3.16.1 Issues

*Issue 4 The effects of additional CBM development on the socioeconomic environment.*

- How will the visual consequences of CBM development affect tourism and tourism revenues and the sales tax revenue, employment, and income tax proceeds derived from tourism?
- Will continued CBM development contribute to a boom-or-bust economy? If so, how will that economic cycle affect quality of life in the affected counties?
- What are the environmental costs of drilling on federal land, and where do industry profits accrue?
- Is infill development economically justified?
- How will continued CBM development affect county revenues from gas royalties and taxes? In addition, how does development affect sales and taxes?
- How will continued CBM development affect demographics, employment, and infrastructure? What are the overall costs and benefits of the proposed project?
- How will gas wells on or near residential properties affect the value of those properties?
- Does CBM development affect property values? If so, is it reflected in reduced valuation on the county tax rolls? Reduced property valuations would result in lost property taxes to the county.
- How will continued CBM development affect the quiet nature and way of life in the project area? Will it result in out-migration of and reduced population numbers? How will it affect traffic and noise?

## 3.16.2 Affected Environment

The Project Area includes portions of La Plata and Archuleta Counties. La Plata County contains most of the population and private land that require county services. The eastern part of the Project Area in Archuleta County is primarily federal land and includes part of the HD Mountains. The data used for this section are countywide, however, because the area of influence considered for social and economic values is larger than the Project Area.

The SUIT Reservation in La Plata and Archuleta Counties is south of and next to the Project Area. The SUIT Reservation holds CBM resources and is the location of current and anticipated CBM development. A separate analysis of the impacts of current and anticipated CBM development of resources in the SUIT Reservation was completed in 2002 (BLM et al. 2002).

Existing oil and gas facilities in the NSJB reflect past development of both conventional and CBM wells; however, there are relatively few conventional wells in the Project Area. Since 1988, most new development of oil and gas in the Project Area has been CBM.

## 3.16.2.1 Population, Employment, Earnings, and Income

The population, employment, earnings, and income characteristics for the Project Area are summarized in this section.

### *3.16.2.1.1 Population*

The estimated population of the City of Durango is more than 14,000. Durango is the center for population and trade nearest to the Project Area. The city is about 2 miles west and northwest of the western edge of the Project Area. The Town of Bayfield, with a population of about 1,550, is near the center of the Project Area. Bayfield has historically been a farm and ranch region and is now becoming a bedroom community for Durango.

As shown in Table 3–159, Table 3–160, and Table 3–161, the 1990s were a period of high population growth for both Archuleta and La Plata Counties, as well as for the entire State of Colorado. Between 1990 and 2000, La Plata County grew by 36 percent and Archuleta County grew by 85 percent, while Colorado's total population increased by 30 percent. Archuleta County experienced extremely high population growth between 1993 and 1998, with 5 consecutive years of annual growth above 5 percent.

Pagosa Springs, Archuleta County's only municipality, grew by 32 percent during the 1990s. At the same time, the unincorporated areas of the county more than doubled in population, from 4,138 residents in April 1990 to 8,307 residents in April 2000. As a result of this differential pattern of growth, a larger share of Archuleta County residents lived in unincorporated areas in 2000 than in 1990.

Population growth is the result of both natural increases (number of births compared with number of deaths) and net migration. The population tables also show net migration. Throughout the 1990s, the contribution of net migration to population growth was larger than natural increases. From 1992 to 1999, net migration contributed almost 83 percent of the growth in La Plata County and 92 percent of the total population growth for Archuleta County. This percentage is higher than the relative population increase of 70 percent attributable to net migration for the state as a whole. Development of CBM was also rapidly increasing in the Project Area during the population growth in the 1990s, as discussed in Section 3.4, Geology.

## Table 3–159 Population Estimates for La Plata County, Colorado, 1990–2000

| | Date | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter/Location | Apr-90 | Jul-91 | Jul-92 | Jul-93 | Jul-94 | Jul-95 | Jul-96 | Jul-97 | Jul-98 | Jul-99 | Apr-00 | Percent Change 1990–2000 | Average Annual Percent Change 1990–2000 |
| *County and Municipal Populations* | | | | | | | | | | | | | |
| La Plata County | 32,284 | 33,411 | 34,429 | 35,598 | 36,906 | 38,760 | 39,704 | 41,173 | 42,173 | 42,757 | 43,941 | 36.1 | 3.1 |
| Bayfield | 1,090 | 1,121 | 1,153 | 1,225 | 1,335 | 1,422 | 1,525 | 1,545 | 1,555 | 1,552 | 1,549 | 42.1 | 3.8 |
| Durango | 12,439 | 12,622 | 12,927 | 12,993 | 13,103 | 13,103 | 13,350 | 13,278 | 13,468 | 13,731 | 13,922 | 11.9 | 1.1 |
| Ignacio | 720 | 715 | 729 | 709 | 693 | 693 | 706 | 709 | 701 | 682 | 669 | -7.1 | -0.7 |
| Unincorporated | 18,035 | 18,953 | 19,620 | 20,671 | 23,542 | 23,542 | 24,123 | 24,786 | 25,449 | 26,792 | 27,801 | 54.2 | 4.9 |
| *Municipal Population Shares Percent* | | | | | | | | | | | | | |
| Bayfield | 3.4 | 3.4 | 3.3 | 3.4 | 3.6 | 3.7 | 3.8 | 3.8 | 3.8 | 3.6 | 3.5 | | |
| Durango | 38.5 | 37.8 | 37.5 | 36.5 | 35.5 | 33.8 | 33.6 | 32.9 | 32.7 | 32.1 | 31.7 | | |
| Ignacio | 2.2 | 2.1 | 2.1 | 2.0 | 1.9 | 1.8 | 1.8 | 1.8 | 1.7 | 1.6 | 1.5 | | |
| Unincorporated | 55.9 | 56.7 | 56.7 | 58.1 | 59.0 | 60.7 | 60.7 | 61.5 | 61.8 | 62.7 | 63.3 | | |
| *Change in County Population with Components of Change* | | | | | | | | | | | | | |
| La Plata County | 32,284 | 33,411 | 34,429 | 35,598 | 36,906 | 38,760 | 39,704 | 40,318 | 41,173 | 42,757 | 43,941 | | |
| Net Change | - | 1,127 | 1,018 | 1,169 | 1,308 | 1,854 | 944 | 614 | 855 | 1,584 | 1,184 | | |
| Percent Change | - | 3.5 | 3.0 | 3.4 | 3.7 | 5.0 | 2.4 | 1.5 | 2.1 | 3.8 | 2.8 | | |
| Births | - | - | 413 | 413 | 479 | 404 | 410 | 464 | 417 | 455 | - | | |
| Deaths | - | - | 201 | 231 | 220 | 245 | 224 | 249 | 231 | 248 | - | | |
| Net Natural Increase | - | - | 212 | 182 | 259 | 159 | 186 | 215 | 186 | 207 | - | | |
| Net Migration[1] | - | - | 806 | 987 | 1,049 | 1,695 | 758 | 399 | 669 | 1,377 | - | | |

Note:

1. Net migration computed by subtracting net natural increase from net change.

Source: CODOLA 2002d

## Table 3–160 Population Estimates for Archuleta County, Colorado, 1990–2000

| | Date | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter/Location | Apr-90 | Jul-91 | Jul-92 | Jul-93 | Jul-94 | Jul-95 | Jul-96 | Jul-97 | Jul-98 | Jul-99 | Apr-00 | Percent Change 1990–2000 | Average Annual Percent Change 1990–2000 |
| *County and Municipal Populations* | | | | | | | | | | | | | |
| Archuleta County | 5,345 | 5,626 | 5,880 | 6,177 | 6,539 | 7,108 | 7,928 | 8,534 | 9,133 | 9,570 | 9,898 | 85.1 | 6.4 |
| Pagosa Springs | 1,207 | 1,232 | 1,271 | 1,291 | 1,320 | 1,362 | 1,513 | 1,587 | 1,605 | 1,597 | 1,591 | 31.8 | 2.9 |
| *Municipal Population Shares Percent* | | | | | | | | | | | | | |
| Pagosa Springs | 22.6 | 21.9 | 21.6 | 20.9 | 20.2 | 19.2 | 19.1 | 18.6 | 17.6 | 16.7 | 16.1 | | |
| *Change in County Population with Components of Change* | | | | | | | | | | | | | |
| Archuleta County | 5,345 | 5,626 | 5,880 | 6,177 | 6,539 | 7,108 | 7,928 | 8,534 | 9,133 | 9,570 | 9,898 | | |
| Net Change | - | 281 | 254 | 297 | 362 | 569 | 820 | 606 | 599 | 437 | 328 | | |
| Percent Change | - | 5.3 | 4.5 | 5.1 | 5.9 | 8.7 | 11.5 | 7.6 | 7.0 | 4.8 | 3.4 | | |
| Births | - | - | 70 | 61 | 76 | 60 | 75 | 96 | 99 | 82 | - | | |
| Deaths | - | - | 26 | 36 | 36 | 36 | 35 | 39 | 48 | 41 | - | | |
| Net Natural Increase | - | - | 44 | 25 | 40 | 24 | 40 | 57 | 51 | 41 | - | | |
| Net Migration[1] | - | - | 210 | 272 | 322 | 545 | 780 | 549 | 548 | 396 | - | | |

Note:

1. Net migration computed by subtracting net natural increase from net change.

Source: CODOLA 2002d

## Table 3–161 Population Estimates for the State of Colorado, 1990–2000

| | Date | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter/Location | Apr-90 | Jul-91 | Jul-92 | Jul-93 | Jul-94 | Jul-95 | Jul-96 | Jul-97 | Jul-98 | Jul-99 | Apr-00 | Percent Change 1990–2000 | Average Annual Percent Change 1990–2000 |
| Population | 3,304,041 | 3,380,951 | 3,489,833 | 3,605,043 | 3,712,065 | 3,811,077 | 3,902,451 | 3,995,924 | 4,102,491 | 4,215,984 | 4,301,261 | 30.2 | 2.7 |
| Net Change | - | 76,910 | 108,882 | 115,210 | 107,022 | 99,012 | 91,374 | 93,473 | 106,567 | 113,493 | 85,277 | | |
| % Change | - | 2.3 | 3.2 | 3.3 | 3.0 | 2.7 | 2.4 | 2.4 | 2.7 | 2.8 | 2.0 | | |
| Births | - | - | 54,156 | 54,269 | 54,028 | 54,176 | 54,943 | 55,933 | 57,823 | 60,641 | - | | |
| Deaths | - | - | 22,480 | 23,083 | 23,951 | 24,523 | 25,221 | 25,517 | 25,991 | 26,737 | - | | |
| Net Natural Increase | - | - | 31,186 | 30,077 | 29,653 | 29,722 | 30,416 | 30,416 | 31,832 | 33,904 | - | | |
| Net Migration | - | - | 77,696 | 85,133 | 77,369 | 69,290 | 60,958 | 63,057 | 74,735 | 79,589 | - | | |

Note:

1. Net migration computed by subtracting net natural increase from net change.

Source: CODLG 2002d

### Population Trends

Overall, the State of Colorado experienced high population growth over the last decade. In addition, the population is projected to continue to increase, although at a much slower rate. As shown in Table 3–162, the total state population is projected to increase at an annual rate of 1.99 percent over the next 25 years, compared with the average annual rate of 2.7 percent during the 1990s (Table 3–161). Similarly, the population of La Plata County grew at an annual rate of 3.1 percent from 1990 to 2000 and is projected to increase by 1.7 percent annually over the next 25 years. The population of Archuleta County is projected to grow more slowly over the next 25 years than over the past decade, but the projected 3.26 percent average annual increase in population is significantly higher than the projected growth in population for the state and region.

**Table 3–162 Population Projections for La Plata County, Archuleta County, and the State of Colorado, 2000–2025**

| | Population by Location | | | |
|---|---|---|---|---|
| Year | La Plata County | Archuleta County | Region 9 Planning Area[1] | Colorado |
| 2000 | 44,183 | 9,952 | 80,511 | 4,324,919 |
| 2001 | 44,415 | 10,540 | 82,801 | 4,406,267 |
| 2002 | 45,626 | 11,039 | 85,102 | 4,488,405 |
| 2003 | 46,829 | 11,535 | 87,406 | 4,568,515 |
| 2004 | 48,026 | 12,030 | 89,715 | 4,648,371 |
| 2005 | 50,150 | 12,441 | 92,032 | 4,733,167 |
| 2010 | 55,839 | 14,922 | 103,426 | 5,170,938 |
| 2015 | 60,837 | 17,394 | 113,744 | 5,617,933 |
| 2020 | 64,105 | 19,842 | 123,077 | 6,067,413 |
| 2025 | 67,378 | 22,199 | 131,710 | 6,523,992 |
| Average Annual Growth (percent change) | 1.70 | 3.26 | 1.66 | 1.99 |

Note:

1. Region 9 Planning Area includes Archuleta, Dolores, La Plata, Montezuma, and San Juan Counties.

Source: CODOLA 2002c

### Household Information

Across the state, the average number of persons per household grew a modest 1.19 percent from 1990 to 2000; however, the ratio of total population to the number of households decreased in both La Plata and Archuleta Counties. The changes in persons per household in La Plata and Archuleta Counties and for the State of Colorado from 1990 to 2000 are summarized in Table 3–163. In 1990, the number of persons per household in both counties was higher than the statewide average. By 2000, conversely, the number of persons per household in La Plata and Archuleta Counties was lower than for the state as a whole.

**Table 3–163 Summary of Household Information, 1990–2000**

| | Households | | Persons per Household | | |
|---|---|---|---|---|---|
| | | | | | Percent Change |
| Area | 1990 | 2000 | 1990 | 2000 | 1990–2000 |
| Colorado | 1,285,119 | 1,658,238 | 2.56 | 2.59 | 1.19 |
| La Plata County | 11,963 | 17,342 | 2.70 | 2.53 | -6.11 |
| Archuleta County | 2,023 | 3,980 | 2.64 | 2.49 | -5.87 |

Source: U.S. Census 1990b, 2000a

### *Racial and Ethnic Composition and Demographics*

As indicated in Table 3–164, the racial composition of the State of Colorado is comparable to that of La Plata and Archuleta Counties. In 2000, the minority population in the state was 17.1 percent and was 12.8 percent in La Plata County and 11.7 percent in Archuleta County. Native American populations were 5.8 percent in La Plata County and 1.4 percent in Archuleta County, compared with the overall 1 percent for the state. Black and Asian populations are much lower in these two counties than statewide. Based on the 2000 Census, 10.4 percent of the population of La Plata County and 16.8 percent of the population of Archuleta County was Hispanic, lower than the state as a whole (17.1 percent).

The population demographics for La Plata and Archuleta Counties and the State of Colorado for 1990 and 2000 are shown in Table 3–165. The age structure of the populations in both counties is comparable to the State of Colorado and to the country as a whole. The middle age group of the population (35 to 64) grew from 1990 to 2000, whereas the youngest age class decreased, which is consistent with the aging of the general population.

### *3.16.2.1.2 Employment*

Trends in La Plata and Archuleta Counties for employment, unemployment, and wages are similar to trends statewide. Both counties and the state experienced dramatic increases in the labor force from 1990 to 1999. In addition, the services category, including agricultural services, is the largest employment sector in the counties, as well as for the state.

The number of employed workers grew faster than the total labor force for the State of Colorado in the 1990s, resulting in a reduction in unemployment by 1999. From 1990 to 1999, total employment in Colorado grew at an average annual rate of 3.1 percent, while the unemployment rate dropped from 5 percent in 1990 to 2.9 percent in 1999. Both La Plata and Archuleta Counties exceeded the statewide rate of growth in employment. Between 1990 and 1999, total employment increased by more than 6.2 percent in La Plata County and grew by 4 percent in Archuleta County. The percent change in employment from 1990 to 1999 is shown on Table 3–166 for La Plata and Archuleta Counties and the State of Colorado.

### Table 3–164 Racial and Ethnic Composition for La Plata County, Archuleta County, and State of Colorado

| Category | 1990 Number | 1990 Portion (percent) | 2000 Number | 2000 Portion (percent) | Percent Change 1990–2000 |
|---|---|---|---|---|---|
| *La Plata County* | | | | | |
| One Race | | | | | |
| White | 29,022 | 89.9 | 38,364 | 87.3 | 32.2 |
| Black | 71 | 0.2 | 136 | 0.3 | 91.5 |
| Native American | 1,602 | 5.0 | 2,539 | 5.8 | 58.5 |
| Asian | 171 | 0.5 | 177 | 0.4 | 3.5 |
| Pacific Islander | 8 | 0.0 | 24 | 0.1 | 200.0 |
| Other | 1,410 | 4.4 | 1,712 | 3.9 | 21.4 |
| Two or more races | | | 989 | 2.3 | |
| Hispanic (of any race) | 3,586 | 11.1 | 4,571 | 10.4 | |
| *Archuleta County* | | | | | |
| One Race | | | | | |
| White | 4,664 | 87.3 | 8,743 | 88.3 | 87.5 |
| Black | 7 | 0.1 | 35 | 0.4 | 400.0 |
| Native American | 107 | 2.0 | 139 | 1.4 | 29.9 |
| Asian | 28 | 0.5 | 31 | 0.3 | 10.7 |
| Pacific Islander | 1 | 0.0 | 3 | 0.0 | 200.0 |
| Other | 538 | 10.1 | 690 | 7.0 | 28.3 |
| Two or more races | | | 257 | 2.6 | |
| Hispanic (of any race) | 1,244 | 23.3 | 1,659 | 16.8 | |
| *Colorado* | | | | | |
| One Race | | | | | |
| White | 2,905,474 | 88.2 | 3,560,005 | 82.8 | 22.5 |
| Black | 133,146 | 4.0 | 165,063 | 3.8 | 24.0 |
| Native American | 27,776 | 0.8 | 44,241 | 1.0 | 59.3 |
| Asian | 57,122 | 1.7 | 95,213 | 2.2 | 66.7 |
| Pacific Islander | 2,740 | 0.1 | 4,621 | 0.1 | 68.6 |
| Other | 168,136 | 5.1 | 309,931 | 7.2 | 84.3 |
| Two or more races | | | 122,187 | 2.8 | |
| Hispanic (of any race) | 424,302 | 12.9 | 735,601 | 17.1 | 73.4 |

Source: U.S. Census 1990a, 2000a

**Table 3–165 Population Demographics for La Plata County, Archuleta County, and State of Colorado**

| Area/Parameter | Age Class | | | |
|---|---|---|---|---|
| | <5 to 34 | 35 to 64 | 65 to 85> | Total |
| La Plata County | | | | |
| 1990 | | | | |
| Population | 17,840 | 11,224 | 3,220 | 32,284 |
| Percent of 1990 Total | 55 | 35 | 10 | |
| 2000 | | | | |
| Population | 21,651 | 18,162 | 4,128 | 43,941 |
| Percent of 2000 Total | 49 | 41 | 10 | |
| Archuleta County | | | | |
| 1990 | | | | |
| Population | 2,633 | 2,091 | 621 | 5,345 |
| Percent of 1990 Total | 49 | 39 | 12 | |
| 2000 | | | | |
| Population | 4,069 | 4,651 | 1,178 | 9,898 |
| Percent of 2000 Total | 41 | 47 | 12 | |
| Colorado | | | | |
| 1990 | | | | |
| Population | 1,808,640 | 1,156,311 | 329,443 | 3,294,394 |
| Percent of 1990 Total | 55 | 35 | 10 | |
| 2000 | | | | |
| Population | 2,194,933 | 1,690,255 | 416,073 | 4,301,261 |
| Percent of 2000 Total | 51 | 39 | 10 | |

Source: U.S. Census 1990b, 2000a

**Table 3–166 Resident Labor Force, Employment, and Unemployment for La Plata County, Archuleta County, and State of Colorado, 1990–1999**

| Category | 1990 | 1995 | 1999 | Percent Change 1990–1999 | Average Annual Rate (percent) |
|---|---|---|---|---|---|
| *La Plata County* | | | | | |
| Labor Force | 17,399 | 23,123 | 24,175 | 38.9 | 3.7 |
| Employed | 16,390 | 22,043 | 23,249 | 41.8 | 4.0 |
| Unemployed | 1,009 | 1,080 | 926 | -8.2 | -0.9 |
| Unemployment Rate | 5.80% | 4.67% | 3.83% | | |
| *Archuleta County* | | | | | |
| Labor Force | 2,682 | 3,581 | 4,561 | 70.1 | 6.1 |
| Employed | 2,547 | 3,409 | 4,384 | 72.1 | 6.2 |
| Unemployed | 135 | 172 | 177 | 31.1 | 3.1 |
| Unemployment Rate | 5.03% | 4.80% | 3.88% | | |
| *Colorado* | | | | | |
| Labor Force | 1,764,181 | 2,087,524 | 2,264,105 | 28.3 | 2.8 |
| Employed | 1,675,124 | 2,000,025 | 2,198,147 | 31.2 | 3.1 |
| Unemployed | 89,057 | 87,499 | 65,958 | -25.9 | -3.3 |
| Unemployment Rate | 5.05% | 4.19% | 2.91% | | |

Source: CODOLA 2002a

### *Employment Activity by Business Sector*

Basic economic activity may be direct or indirect. Direct basic employment and income are generated when an industry exports goods and services or attracts expenditures from other outside sources, such as tourists. Indirect basic industries supply goods and services to the direct basic industries. Direct and indirect basic employment generates additional employment because of the goods and services that resident employees demand of local businesses. The local economic base consists of industries that bring in dollars from outside the regional economy. Basic income and employment in the Project Area result from various local industries.

In La Plata County, direct basic activities account for 43 percent of all employment, generating more than 13,000 jobs (Region 9 EDD 2003). Although it is not a specific industrial category, tourism is considered a wholly direct basic activity, because it consists of expenditures from outside visitors. Tourism itself is a collection of other sectors, such as retail trade and services, hotel, lodging, and eating-and-drinking establishments. Tourism is the largest basic industry employer in the county, accounting for more than 8,000 jobs and resulting in 62 percent of direct basic employment (Region 9 EDD 2003). In comparison, agricultural production and services generate 4.7 percent of total direct basic employment, and oil and gas extraction results in 1.9 percent of total direct basic employment (Region 9 EDD 2003). In La Plata County, almost three-quarters of agricultural employment is defined as a direct basic employment sector; however, oil and gas extraction is wholly a direct basic employment sector.

The income these industries generate is not directly proportional to the employment percentages. For example, jobs in the agricultural and service sectors are lower paying; therefore, these sectors contribute less to total income than do higher-paying jobs in other sectors. In addition, tourism provides 62 percent of the direct basic employment but accounts for only 35.7 percent of all direct basic income (Region 9 EDD 2003). In contrast, oil and gas extraction accounts for more income, compared with its share of employment. Oil and gas extraction contributes 3.6 percent of direct basic income in La Plata County but only 1.9 percent of total direct basic employment (Region 9 EDD 2003).

The largest job sector from 1990 to 1999 in La Plata County was the services industry, including agricultural services, which represented 35 percent of the jobs in the county. Retail trade and government were the only other sectors that accounted for more than 10 percent of the jobs (Table 3–167). For these job categories, the largest change between 1990 and 1999 was in financial services, insurance, and real estate, with an average annual increase of 6.8 percent (Table 3–167).

The largest job sector in Archuleta County from 1990 to 1999 was the services industry, including agricultural services, which represented 34 percent of the jobs in the county. Retail trade accounted for 20 percent of the jobs; government and financial services, insurance, and real estate were the only other sectors with more than 10 percent of the jobs (Table 3–168). For these categories, the largest change between 1990 and 1999 was an annual average increase of 30 percent in the construction sector. From 1990 to 1999, the average annual increase in wholesale trade was 19 percent, and financial services, insurance, and real estate increased by 14 percent (Table 3–168).

## Table 3–167 Employment and Earnings by Place of Work for La Plata County, 1990–1999

| Category | 1990 | 1995 | 1999 | Average 1990–1999 | Average Annual Change 1990–1999 |
|---|---|---|---|---|---|
| Full and Part Time Jobs | | | | | |
| Farm | 903 | 857 | 833 | 863 | -0.9% |
| Mining | 324 | 432 | 332 | 379 | 0.3% |
| Construction | 1,741 | 2,626 | 3,090 | 2,413 | 6.6% |
| Manufacturing | 689 | 1,017 | 1,072 | 930 | 5.0% |
| Transportation & Public Utilities | 706 | 845 | 982 | 813 | 3.7% |
| Wholesale Trade | 522 | 723 | 826 | 689 | 5.2% |
| Retail Trade | 3,734 | 5,528 | 6,130 | 5,135 | 5.7% |
| Financial Services, Insurance and Real Estate | 1,451 | 2,047 | 2,617 | 1,976 | 6.8% |
| Services, Including Agricultural Services | 6,687 | 9,744 | 11,069 | 9,209 | 5.8% |
| Government | 3,218 | 3,480 | 3,814 | 3,532 | 1.9% |
| Total Employees | 19,975 | 27,299 | 30,765 | 25,940 | 4.9% |
| Percent by Sector (Column %) | | | | | |
| Farm | 4.5% | 3.1% | 2.7% | 3.4% | |
| Mining | 1.6% | 1.6% | 1.1% | 1.5% | |
| Construction | 8.7% | 9.6% | 10.0% | 9.2% | |
| Manufacturing | 3.4% | 3.7% | 3.5% | 3.6% | |
| Transportation & Public Utilities | 3.5% | 3.1% | 3.2% | 3.1% | |
| Wholesale Trade | 2.6% | 2.6% | 2.7% | 2.7% | |
| Retail Trade | 18.7% | 20.2% | 19.9% | 19.8% | |
| Financial Services, Insurance and Real Estate | 7.3% | 7.5% | 8.5% | 7.6% | |
| Services, Including Agricultural Services | 33.5% | 35.7% | 36.0% | 35.4% | |
| Government | 16.1% | 12.7% | 12.4% | 13.8% | |
| Total Employees | 100.0% | 100.0% | 100.0% | 100.0% | |
| Earnings by Industry ($000s) | | | | | |
| Farm | $1,240 | -$1,501 | -$1,542 | -$816 | |
| Mining | $7,640 | $15,130 | $17,377 | $13,486 | |
| Construction | $43,828 | $68,778 | $89,801 | $66,513 | |
| Manufacturing | $9,733 | $20,498 | $24,981 | $17,665 | |
| Transportation & Public Utilities | $20,493 | $28,876 | $41,801 | $29,245 | |
| Wholesale Trade | $11,113 | $18,367 | $25,927 | $17,761 | |
| Retail Trade | $45,290 | $75,795 | $104,138 | $73,499 | |
| Financial Services, Insurance and Real Estate | $12,777 | $36,755 | $53,705 | $32,618 | |
| Services, Including Agricultural Services | $105,740 | $193,006 | $247,498 | $177,764 | |
| Government | $80,808 | $101,764 | $126,480 | $103,236 | |
| Total Employees | $338,662 | $557,468 | $730,166 | $530,991 | |
| Earnings per Employee | | | | | |
| Farm | $1,373 | -$1,751 | -$1,851 | -$1,037 | |
| Mining | $23,580 | $35,023 | $52,340 | $35,748 | |
| Construction | $25,174 | $26,191 | $29,062 | $27,527 | |
| Manufacturing | $14,126 | $20,155 | $23,303 | $18,564 | |
| Transportation & Public Utilities | $29,027 | $34,173 | $42,567 | $35,362 | |
| Wholesale Trade | $21,289 | $25,404 | $31,389 | $25,269 | |
| Retail Trade | $12,129 | $13,711 | $16,988 | $14,120 | |
| Financial Services, Insurance and Real Estate | $8,806 | $17,956 | $20,522 | $15,677 | |
| Services, Including Agricultural Services | $15,813 | $19,808 | $22,360 | $18,973 | |
| Government | $25,111 | $29,243 | $33,162 | $29,113 | |
| Total Employees | $176,429 | $219,912 | $269,841 | $219,419 | |

Sources Bureau of Economic Analysis 2003

## Table 3–168 Employment and Earnings by Place of Work for Archuleta County, 1990–1999

| Category | 1990 | 1995 | 1999 | Average 1990–1999 | Average Annual Change 1990–1999 |
|---|---|---|---|---|---|
| Full and Part Time Jobs | | | | | |
| Farm | 215 | 229 | 245 | 226 | 1.5% |
| Mining | 34 | 51 | 52 | 42 | 4.8% |
| Construction | 87 | 533 | 935 | 473 | 30.2% |
| Manufacturing | 72 | 91 | 118 | 108 | 5.6% |
| Transportation & Public Utilities | 67 | 96 | 110 | 101 | 5.7% |
| Wholesale Trade | 13 | 27 | 60 | 34 | 18.5% |
| Retail Trade | 525 | 867 | 1,201 | 844 | 9.6% |
| Financial Services, Insurance, and Real Estate | 268 | 490 | 894 | 523 | 14.3% |
| Services, Including Agricultural Services | 1,094 | 1,351 | 1,652 | 1,319 | 4.7% |
| Government | 409 | 455 | 550 | 461 | 3.3% |
| Total Employees | 2,784 | 4,190 | 5,817 | 4,130 | 8.5% |
| Percent by Sector (Column %) | | | | | |
| Farm | 7.6% | 6.0% | 4.5% | 6.1% | |
| Mining | 1.0% | 1.1% | 0.9% | 1.1% | |
| Construction | 3.2% | 9.8% | 15.2% | 8.9% | |
| Manufacturing | 2.8% | 3.3% | 2.0% | 2.8% | |
| Transportation & Public Utilities | 3.4% | 3.1% | 2.3% | 2.6% | |
| Wholesale Trade | 0.2% | 0.5% | 1.2% | 0.7% | |
| Retail Trade | 19.7% | 21.5% | 20.1% | 20.2% | |
| Financial Services, Insurance, and Real Estate | 10.1% | 11.5% | 15.2% | 11.7% | |
| Services, Including Agricultural Services | 38.6% | 31.7% | 29.2% | 33.9% | |
| Government | 13.3% | 11.4% | 9.5% | 12.0% | |
| Total Employees | 100.0% | 100.0% | 100.0% | 100.0% | |
| Earnings by Industry ($000s) | | | | | |
| Farm | $1,421,000 | -$708,000 | -$1,320,000 | -$377,800 | |
| Mining | $1,473,000 | $871,000 | $1,332,000 | $849,000 | |
| Construction | N/A[1] | N/A | $18,934,000 | $14,502,000 | |
| Manufacturing | $1,294,000 | $1,456,000 | $2,259,000 | $1,704,000 | |
| Transportation & Public Utilities | $2,648,000 | $4,154,000 | $6,027,000 | $4,338,444 | |
| Wholesale Trade | N/A | N/A | $2,235,000 | $1,943,750 | |
| Retail Trade | $5,681,000 | $10,372,000 | $16,859,000 | $10,429,000 | |
| Financial Services, Insurance, and Real Estate | $1,942,000 | $6,649,000 | $13,083,000 | $6,806,800 | |
| Services, Including Agricultural Services | N/A | $16,357,000 | $18,936,000 | $15,054,625 | |
| Government | $8,728,000 | $11,820,000 | $15,919,000 | $11,785,500 | |
| Total Employees | $38,891,000 | $61,312,000 | $94,264,000 | $61,232,800 | |
| Earnings per Employee | | | | | |
| Farm | $6,609 | -$3,092 | -$5,388 | -$1,351 | |
| Mining | $43,324 | $17,078 | $25,615 | $19,742 | |
| Construction | N/A | N/A | $20,250 | $17,624 | |
| Manufacturing | $17,972 | $16,000 | $19,144 | $15,847 | |
| Transportation & Public Utilities | $39,522 | $43,271 | $54,791 | $44,961 | |
| Wholesale Trade | N/A | N/A | $37,250 | $34,029 | |
| Retail Trade | $10,821 | $11,963 | $14,037 | $12,105 | |
| Financial Services, Insurance, and Real Estate | $7,246 | $13,569 | $14,634 | $11,895 | |
| Services, Including Agricultural Services | N/A | $12,107 | $11,462 | $11,295 | |
| Government | $21,340 | $25,978 | $28,944 | $25,348 | |
| Total Employees | | | | | |

Note:

1. N/A = Not Available

Sources Bureau of Economic Analysis 2003

Similar trends were evident for the State of Colorado from 1990 to 1999, as shown in Table 3–169. The largest job sector was the services industry, including agriculture, with 32 percent of the jobs. Retail trade and government were the only other sectors that accounted for more than 10 percent of the jobs. Between 1990 and 1999, the largest change in these job categories was in construction, with an average annual increase of 9 percent.

Total statewide employment in oil and gas extraction diminished throughout the 1990s, falling more than 50 percent. Table 3–170 shows employment and earning in oil and gas from 1990 to 1999. Fewer people in La Plata County were employed in the oil and gas industry in 1999 than in 1990. In contrast, employment in oil and gas grew during the first half of the 1990s.

The oil and gas industry has traditionally been an important source of employment in southern Colorado. Employment and earnings from the oil and gas sector from 1990 to 1999 are shown in Table 3–169. Statewide earnings for employees in the oil and gas industry increased more than 150 percent during the 1990s. The number of people in La Plata County employed in the oil and gas industry fell between 1990 and 1999; however, total earnings increased, resulting in a dramatic rise in per capita earnings. The 1999 per capita earnings for people employed in the oil and gas industry in La Plata County were more than 200 percent higher than in 1990.

Although these increases in per capita earnings were significant, they represent a small share of the total earnings in La Plata County. In 1999, employees in the oil and gas industry accounted for only about 2.5 percent of all earnings in the county (CODOLA 2002b).

### *Employment Trends and Projections*

From 1990 to 2000, the number of jobs increased in both La Plata and Archuleta Counties (Table 3–171). There were 60 percent more jobs in La Plata County in 2000 than in 1990. There were 90 percent more jobs in 2000 in Archuleta County, compared with 1990. Although this pace of growth in employment is not expected to continue, both counties are projected to see continued expansion of the employment base (Table 3–171).

Throughout the 1990s, more workers commuted into La Plata County than commuted out (Table 3–171). Furthermore, projections for employment indicate that La Plata County will continue to be a large net importer of employees through the year 2025. In contrast, Archuleta County was a net exporter of employees in the 1990s, because more employees commuted out of the county than into it (Table 3–171). Although Archuleta County's employment base is also projected to grow through the year 2025, its workforce may grow at a higher rate. This trend indicates that residents of Archuleta County will continue to commute to other counties to work.

## Table 3–169 Employment and Earnings by Place of Work for the State of Colorado, 1990–1999

| Category | 1990 | 1995 | 1999 | Average 1990–1999 | Average Annual Change 1990–1999 |
|---|---|---|---|---|---|
| Full and Part Time Jobs | | | | | |
| Farm | 43,690 | 39,739 | 44,360 | 42,294 | 0.2% |
| Mining | 31,384 | 25,831 | 22,076 | 26,284 | -3.8% |
| Construction | 97,386 | 149,956 | 206,579 | 147,216 | 8.7% |
| Manufacturing | 197,879 | 205,233 | 217,141 | 205,452 | 1.0% |
| Transportation & Public Utilities | 107,235 | 130,759 | 157,743 | 128,272 | 4.4% |
| Wholesale Trade | 92,254 | 106,194 | 116,854 | 104,330 | 2.7% |
| Retail Trade | 344,149 | 434,124 | 478,687 | 414,967 | 3.7% |
| Financial Services, Insurance, and Real Estate | 179,826 | 208,084 | 280,864 | 212,751 | 5.1% |
| Services, Including Agricultural Services | 628,547 | 795,071 | 948,643 | 780,138 | 4.7% |
| Government | 332,420 | 353,129 | 373,321 | 356,444 | 1.3% |
| Total Employees | 2,054,770 | 2,448,120 | 2,846,268 | 2,418,149 | 3.7% |
| Percent by Sector (Column %) | | | | | |
| Farm | 2.1% | 1.6% | 1.6% | 1.8% | |
| Mining | 1.5% | 1.1% | 0.8% | 1.1% | |
| Construction | 4.7% | 6.1% | 7.3% | 6.0% | |
| Manufacturing | 9.6% | 8.4% | 7.6% | 8.6% | |
| Transportation & Public Utilities | 5.2% | 5.3% | 5.5% | 5.3% | |
| Wholesale Trade | 4.5% | 4.3% | 4.1% | 4.3% | |
| Retail Trade | 16.7% | 17.7% | 16.8% | 17.2% | |
| Financial Services, Insurance, and Real Estate | 8.8% | 8.5% | 9.9% | 8.7% | |
| Services, Including Agricultural Services | 30.6% | 32.5% | 33.3% | 32.2% | |
| Government | 16.2% | 14.4% | 13.1% | 14.9% | |
| Total Employees | 100.0% | 100.0% | 100.0% | 100.0% | |
| Earnings by Industry ($000s) | | | | | |
| Farm | $912,477 | $512,211 | $911,182 | $692,106 | |
| Mining | $1,168,710 | $1,435,474 | $1472,740 | $1314,519 | |
| Construction | $2,547,432 | $4,659,131 | $7,540,324 | $4,688,665 | |
| Manufacturing | $6,545,084 | $7,989,580 | $10,196,289 | $8,100,087 | |
| Transportation & Public Utilities | $4,302,248 | $6,620,614 | $10,347,280 | $6,685,205 | |
| Wholesale Trade | $2,866,171 | $3,989,366 | $5,536,857 | $3,983,749 | |
| Retail Trade | $4,491,652 | $6,588,106 | $9,066,570 | $6,516,716 | |
| Financial Services, Insurance, and Real Estate | $3,064,540 | $5,433,737 | $9,204,581 | $5,532,218 | |
| Services, Including Agricultural Services | $12,624,228 | $19,562,480 | $29,145,136 | $19,527,637 | |
| Government | $6,784,841 | $12,513,875 | $14,873,831 | $12,076,942 | |
| Total Employees | $45,307,383 | $69,304,574 | $98,294,790 | $69,117,843 | |
| Earnings per Employee ($) | | | | | |
| Farm | $20,885 | $12,889 | $20,541 | $16,325 | |
| Mining | $37,239 | $55,572 | $66,712 | $51,157 | |
| Construction | $26,158 | $31,070 | $36,501 | $31,163 | |
| Manufacturing | $33,076 | $38,929 | $46,957 | $39,265 | |
| Transportation & Public Utilities | $40,120 | $50,632 | $65,596 | $51,112 | |
| Wholesale Trade | $31,068 | $37,567 | $47,383 | $37,759 | |
| Retail Trade | $13,051 | $15,176 | $18,940 | $15,518 | |
| Financial Services, Insurance, and Real Estate | $17,042 | $26,113 | $32,772 | $25,280 | |
| Services, Including Agricultural Services | $20,085 | $24,605 | $30,723 | $24,591 | |
| Government | $20,410 | $35,437 | $39,842 | $33,728 | |
| Total Employees | $259,135 | $327,990 | $405,967 | $325,896 | |

Sources Bureau of Economic Analysis 2003

### Table 3–170 Employment and Earnings in Oil and Gas, 1990–1999

| Category | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| *Colorado* | | | | | | | | | | |
| Employment | 20,817 | 20,253 | 17,589 | 17,280 | 13,825 | 15,321 | 14,148 | 20,726 | 10,877 | 9,598 |
| Total Earnings ($000s) | $775,482 | $716,080 | $746,586 | $862,758 | $987,040 | $1,007,235 | $1,026,669 | $858,932 | $912,085 | $910,708 |
| Per Employee Earnings | $37,252 | $35,356 | $42,447 | $49,927 | $71,394 | $65,743 | $72,568 | $41,443 | $83,851 | $94,886 |
| *La Plata County* | | | | | | | | | | |
| Employment | 363 | 444 | 489 | 394 | 408 | 420 | 377 | 276 | 272 | 252 |
| Total Earnings ($000s) | $5,669 | $7,915 | $8,972 | $8,615 | $11,522 | $12,103 | $13,531 | $11,710 | $12,243 | $13,468 |
| Per Employee Earnings | $15,617 | $17,827 | $18,348 | $21,865 | $28,240 | $28,817 | $35,891 | $42,428 | $45,011 | $53,444 |

Note: No data available for Archuleta County.
Sources: Bureau of Economic Analysis 2003, CODOLA 2002b

### Table 3–171 Projected Employment and Commuting Patterns to 2025 for La Plata and Archuleta Counties

| Area | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|---|---|
| *La Plata County* | | | | | | | | |
| Total Jobs | 19,191 | 26,260 | 30,811 | 35,630 | 40,993 | 45,324 | 49,947 | 53,803 |
| Commuting Out | 833 | 850 | 900 | 925 | 950 | 975 | 1,000 | 1,025 |
| Commuting In | 1,623 | 4,150 | 5,559 | 6,710 | 8,412 | 10,041 | 12,682 | 15,468 |
| Difference | -790 | -3,300 | -4,659 | -5,785 | -7,462 | -9,066 | -11,682 | -14,443 |
| *Archuleta County* | | | | | | | | |
| Total Jobs | 2,724 | 3,611 | 5,222 | 6,128 | 7,097 | 7,843 | 8,629 | 9,283 |
| Commuting Out | 332 | 489 | 900 | 1,850 | 6,295 | 8,218 | 10,047 | 12,760 |
| Commuting In | 175 | 125 | 132 | 346 | 4,050 | 5,050 | 6,050 | 8,050 |
| Difference | 157 | 364 | 768 | 1,504 | 2,245 | 3,168 | 3,997 | 4,710 |

Source: CODOLA 2002d

The portions of residents in La Plata and Archuleta Counties living below the poverty line were greater than the Colorado statewide average. In 1990, the portions of residents in the two counties living below the poverty line were about 33 percent higher than the statewide average (Table 3–172). By 1999 to 2000, the portions of residents living below the poverty line had decreased in both counties and statewide. Although the portion of residents living below the poverty line in La Plata County relative to the statewide average declined from 1990, the portion in Archuleta County relative to the statewide average increased (Table 3–172).

### Table 3–172 Measures of Income and Persons below Poverty Line in Colorado, La Plata and Archuleta Counties

| Area | Per Capita Income | | Median Household Income | | Percent of Persons Below Poverty | |
|---|---|---|---|---|---|---|
| | 1990 ($) | 2000 ($) | 1990 ($) | 2000 ($) | 1990 | 1999[1] |
| Colorado | 14,602 | 21,600 | 30,172 | 41,659 | 11.7 | 8.9 |
| La Plata County | 11,977 | 17,029 | 25,787 | 35,219 | 15.7 | 10.4 |
| Archuleta County | 10,953 | 15,256 | 23,089 | 31,501 | 16.3 | 12.7 |

Note:
[1] Year 1999 used because data for 2000 were not available.
Source: U.S. Census 1990c, 2000b, 2000c

### *Household Income*

The median household incomes in both counties have increased at roughly the same rate as the statewide average. In the year 2000, incomes for nearly 50 percent of the households in these two counties were less than $20,000. Household incomes in the year 2000 for La Plata and Archuleta Counties and the state are shown in Table 3–173.

**Table 3–173 Households by Income for La Plata and Archuleta Counties, and Colorado, 2000**

| Households by Income | La Plata County | | Archuleta County | | Colorado | |
|---|---|---|---|---|---|---|
| | Households | Percent | Households | Percent | Households | Percent |
| Less than $5,000 | 837 | 5.4 | 180 | 4.8 | 65,290 | 4.1 |
| $5,000 to $9,999 | 1,067 | 6.9 | 369 | 9.9 | 89,298 | 5.6 |
| $10,000 to $14,999 | 838 | 5.4 | 229 | 6.1 | 67,096 | 4.2 |
| $15,000 to $19,999 | 1,636 | 10.6 | 399 | 10.7 | 127,098 | 7.9 |
| $20,000 to $24,999 | 1,164 | 7.5 | 282 | 7.5 | 105,636 | 6.6 |
| $25,000 to $29,999 | 1,154 | 7.4 | 313 | 8.4 | 106,345 | 6.6 |
| $30,000 to $34,999 | 996 | 6.4 | 333 | 8.9 | 90,865 | 5.7 |
| $35,000 to $39,999 | 1,308 | 8.4 | 256 | 6.8 | 125,332 | 7.8 |
| $40,000 to $49,999 | 1,517 | 9.8 | 309 | 8.3 | 149,802 | 9.3 |
| $50,000 to $59,999 | 1,309 | 8.4 | 288 | 7.7 | 162,099 | 10.1 |
| $60,000 to $74,999 | 1,196 | 7.7 | 286 | 7.6 | 188,502 | 11.8 |
| $75,000 to $99,999 | 1,237 | 8.0 | 225 | 6.0 | 175,743 | 11.0 |
| $100,000 to $124,999 | 509 | 3.3 | 135 | 3.6 | 71,317 | 4.4 |
| $125,000 to $149,999 | 309 | 2.0 | 45 | 1.2 | 29,210 | 1.8 |
| $150,000 and over | 422 | 2.7 | 95 | 2.5 | 50,053 | 3.1 |
| Total | 15,499 | | 3,744 | | 1,603,686 | |

Source: U.S. Census 2000b

## 3.16.2.2 Housing

Housing is generally available in the Project Area in both counties. The number of housing units, households, building units, and vacant housing units for La Plata and Archuleta Counties between 1990 and 1999 is shown in Table 3–174 and Table 3–175.

In 1999, almost 6,700 housing units were vacant in La Plata and Archuleta Counties (Table 3–174 and Table 3–175). Some of the vacant housing is attributable to second homes used for recreation or vacation (or rented for recreation or vacation) and to vacant housing units sold. Part-time residents account for 35 percent of the households in Archuleta County (Archuleta County 2001a).

Some of the housing units in La Plata County are rentals: apartments, condominiums, and single-family homes. In 2001, there were an estimated 9,000 rental units in La Plata County (Holmes 2001). Monthly rents range from $450 for a studio or one-bedroom apartment to more than $1,500 for a single-family home (Holmes 2001). Average monthly rent in Durango was $714 for the first quarter of 2001, up 11.5 percent from the third quarter of 2000 (CODOLA 2003a).

### Table 3–174 Housing, Households, Building Permits, and Vacant Housing in La Plata County, 1990–1999

| Housing | Year<br>1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| Housing Units | 15,412 | 15,657 | 15,921 | 16,613 | 17,165 | 17,755 | 19,237 | 19,768 | 20,233 | 20,747 |
| Percent Change | -2.7% | 1.6% | 1.7% | 4.3% | 3.3% | 3.4% | 8.3% | 2.8% | 2.4% | 2.5% |
| Net Building Permits[1] | 245 | 264 | 392 | 467 | 590 | 643 | 514 | 465 | 514 | N/A |
| Percent Change | 23.7% | 7.8% | 48.5% | 19.1% | 26.3% | 9.0% | -20.1% | -9.5% | 10.5% | N/A |
| Total Households | 11,976 | 12,363 | 12,743 | 13,287 | 13,767 | 14,316 | 14,979 | 15,324 | 15,716 | 15,976 |
| Percent Change | 3.6% | 3.2% | 3.1% | 4.3% | 3.6% | 4.0% | 4.6% | 2.3% | 2.6% | 1.7% |
| Vacant Units[2] | 3,436 | 3,294 | 3,178 | 3,326 | 3,398 | 3,439 | 4,258 | 4,444 | 4,517 | 4,771 |
| Percent Change | -19.6% | -4.1% | -3.5% | 4.7% | 2.2% | 1.2% | 23.8% | 4.4% | 1.6% | 5.6% |

Note:

1. Building permits include both private and public new housing units; data prior to 1995 subtracted demolitions. In most cases, the permits do not cover mobile homes or trailers.
2. Vacant housing units are computed by subtracting total households from total housing units. Households (total occupied housing units) are estimated from total housing units, household population, and persons per household.

Source: CODOLA 2001a

### Table 3–175 Housing, Households, Building Permits, and Vacant Housing in Archuleta County, 1990–1999

| Housing | Year<br>1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| Housing Units | 3,951 | 4,023 | 4,086 | 4,193 | 4,294 | 4,483 | 4,731 | 4,980 | 5,223 | 5,536 |
| Percent Change | -3.2% | 1.8% | 1.6% | 2.6% | 2.4% | 4.4% | 5.5% | 5.3% | 4.9% | 6.0% |
| Net Building Permits[1] | 72 | 63 | 107 | 101 | 189 | 248 | 249 | 243 | 308 | N/A |
| Percent Change | 5.9% | -12.5% | 69.8% | -5.6% | 87.1% | 31.2% | 0.4% | -2.4% | 26.7% | N/A |
| Total Households | 2,010 | 2,076 | 2,147 | 2,324 | 2,456 | 2,671 | 2,987 | 3,239 | 3,452 | 3,619 |
| Percent Change | 6.6% | 3.3% | 3.4% | 8.2% | 5.7% | 8.8% | 11.8% | 8.4% | 6.6% | 4.8% |
| Vacant Units[2] | 1,941 | 1,947 | 1,939 | 1,869 | 1,838 | 1,812 | 1,744 | 1,741 | 1.771 | 1,917 |
| Percent Change | -11.7% | 0.3% | -0.4% | -3.6% | -1.7% | -1.4% | -3.8% | -0.2% | 1.7% | 8.2% |

Notes:

1. Building permits include both private and public new housing units; data for years before 1995 subtracted demolitions. In most cases, the permits do not cover mobile homes or trailers.
2. Vacant housing units are computed by subtracting total households from total housing units and include both seasonal and vacant units. Households (total occupied housing units) are estimated from total housing units, household population, and persons per household.

Source: CODOLA 2001a

The vacancy rate for rental housing in La Plata County fluctuates, but suggests that rental housing is in short supply overall. In 2000, the vacancy rate was 1.4 percent for the first quarter but 6.2 percent for the third quarter (CODOLA 2003a). The vacancy rate for rental housing in La Plata County had dropped to 2.9 percent for the first quarter of 2001. This tight rental market appears primarily to be attributable to the following factors:

Demand created by students at Fort Lewis College,

Employees in the tourism- and recreation-based economy, and

Positive net migration that is likely contributing to high occupancy of rental homes.

In addition to rental housing, mobile homes are available in La Plata County. As of June 2001, La Plata County had 51 mobile home parks with a total of 1,382 pads (Larson 2001). Most of the mobile home parks are small (70 percent have fewer than 30 pads).

## 3.16.2.3 Facilities, Services, and Infrastructure

Development of CBM has the potential to affect existing community facilities, services, and infrastructure. The use of existing facilities or infrastructure, including roads and bridges, may affect the capacity of service agencies or transportation systems or may require new facilities. Growth in population and employment may also affect local-community facilities, services, and infrastructure in the Project Area. The following sections characterize existing country road and bridge facilities, public services, and general-government services in La Plata and Archuleta Counties.

### *3.16.2.3.1 County Road and Bridge*

Most of the county roads in the Project Area are in La Plata County. About 173 miles of county roads in La Plata County are paved. Another 485 miles of county roads are gravel (La Plata County 2002a). The Project Area does not contain any roads maintained by Archuleta County. Most land in the Archuleta County portion of the Project Area is within the Columbine Ranger District of the San Juan National Forest. Therefore, with the exception of U.S. Highway 160 and State Route 151, roads in the Project Area in Archuleta County are National Forest System Roads maintained by the San Juan National Forest.

From 1997 to 2002, expenditures by the La Plata County Road and Bridge Department almost doubled. Expenditures increased from $8.9 million in 1997 to $19.1 million in 2000 (La Plata County 2002a). Capital expenditures and improvements on roads and bridges account for most of the increased expenditures.

### *3.16.2.3.2 Public Services*

The local-government services that the proposed project may affect are law enforcement, emergency response, utilities (power and water), hospitals, and schools. A summary of the local-government services for La Plata and Archuleta Counties is displayed in Table 3–176 and discussed in this section.

The two fire districts that serve the portion of the Project Area in La Plata County are the Durango Fire and Rescue Authority and the Upper Pine Fire Protection District (La Plata County 1999). The Upper Pine Fire Protection District serves most of the eastern portion of La Plata County, including the Town of Bayfield.

The City of Durango provides water to the incorporated and adjacent unincorporated areas (City of Durango 1997). The city's water is supplied from the Florida and Animas Rivers. The Durango Fire and Rescue Authority provides fire protection and emergency medical services in the Durango planning area outside the city limits, including the northwestern portion of the Project Area.

## Table 3–176 Summary of Local-Government Services for La Plata and Archuleta Counties

| Service | Description |
|---|---|
| Law Enforcement | **La Plata County**<br>Law enforcement is provided by a combination of municipal and county agencies, including the following:<br>City of Durango Police Department (staff of 52)<br>City of Bayfield (staff of six with four vehicles) |
| | **Archuleta County**<br>Law enforcement is provided by a combination of municipal and county agencies, including the following:<br>Archuleta County Sheriff's Office (staff of 29)<br>Pagosa Springs Police Department (staff of nine and eight vehicles) |
| Education | **La Plata County**<br>Schools are administered through three districts:<br>Durango School District (seven elementary, two middle, one high school)<br>Bayfield School District (one elementary, one middle, one high school)<br>Ignacio School District (one elementary [K-4], one intermediate [5-6], one junior. and one senior. high school) |
| | **Archuleta County**<br>Schools are administered through the Archuleta School District-joint 50, which has one elementary (K-4), one intermediate (5-6), one junior, and one senior high school serving the entire county. |
| Fire/ Ambulance | **La Plata County**<br>Fire and medical response services are provided by a combination of municipal and county agencies, including the following:<br>Durango Fire and Rescue Authority (staff of 52)<br>Upper Pine Fire Protection District/Department (includes Bayfield) |
| | **Archuleta County**<br>Fire and medical response services are provided by a combination of municipal and county agencies, including the following:<br>Pagosa Fire Protection District/Fire Department<br>Upper San Juan Hospital District provides ambulance service |
| Hospitals | **La Plata County**<br>Mercy Medical Center serves all surrounding towns in and outside La Plata County. San Juan Basin Health provides additional care, and Four Corners Nursing Home (156 beds) provides care for the elderly. Numerous dental, physician, therapist, and optometrist practices in Durango serve the region. |
| | **Archuleta County**<br>Upper San Juan Hospital district includes an EMS facility for emergency treatment and a family practice and associated clinic for outpatient treatment. In-patient services are provided by Mercy Medical Center of Durango. |
| Utilities | La Plata Electric Association (LPEA) is a rural electric provider serving both Archuleta and La Plata Counties. Serving 33,321 customers in 2000, the utility has seen a rise from 107 to 143 megawatts (MW) in peak demand and produces power at a cost of $0.0347 per kilowatt-hour. Citizens Other utilities provide natural gas in incorporated areas in La Plata and Archuleta Counties. Propane is provided by numerous businesses such as Arrow Gas and Mesa Propane in La Plata County and Columbia Propane or Ferrell Gas in Archuleta County. Water is supplied to incorporated areas of La Plata County by the City of Durango and to incorporated areas of Archuleta County by the Pagosa Area Water and Sanitation District |

Source: BBC 2001a

Fire protection in the unincorporated portion of Archuleta County is offered in part by the Pagosa Fire Protection District. Under cooperative agreements, the FS and Colorado State Forest Service assist in firefighting in forested areas of the county.

#### 3.16.2.3.3 General Government

The La Plata County Planning Services Department is responsible for permitting land development in La Plata County, including oil and gas. The number of oil and gas development projects reviewed increased from 33 in 1997 to 73 in 2000, with an associated increase in workload projected for the future. The department reviewed 271 applications for land-use permits of all kinds in 2000 (Keller 2001).

Other general-government units in La Plata County that would be affected by or that exercise jurisdiction over aspects of oil and gas development are County Administrative Services (negotiating impact-mitigation measures), the Board of County Commissioners (conflict resolution), the Assessor's Office (reporting royalty interest), and the County Attorney (negotiation and litigation).

### 3.16.2.4 Fiscal Conditions of Local Government

La Plata and Archuleta Counties receive revenues from development of oil and gas in a variety of ways. The most important source of revenue related to oil and gas development is the *ad valorem* property tax on production and field equipment. These taxes are levied on the assessed value of natural gas produced during the previous year, as well as on the treatment and transmission facilities and other real property involved in production of gas. Other potential sources for county revenue that are attributed to production of natural gas include redistribution of severance-taxes grants from the Colorado Energy and Mineral Impact Assistance Fund and distribution of rental and royalty fees collected by the U.S. Department of the Interior for development of federally owned minerals.

The analysis of county revenues paid by the oil and gas industry focuses primarily on La Plata County because there are currently only 12 CBM wells in Archuleta County (Anderson 2003). Within the Project Area, COGCC indicates that only four gas wells are currently producing in Archuleta County, and an additional eight wells have been active during the past decade (BBC 2001a).

#### 3.16.2.4.1 Assessed Valuation

The county assessor assigns a taxable value to all real or personal property in the county as a basis for generating property tax revenues. The actual value of a property is not the taxable value. Rather, the assessed value is a percentage of the actual value of the property.

The assessed value for producing oil and gas properties is based on the earnings from production. The counties and other special tax districts classify the value of production as real property for properties with producing gas wells, regardless of surface or mineral ownership. The assessed value for producing oil and gas leaseholds and lands is 87.5 percent of the average wellhead price of the oil and gas sold or transported from the premises of primary recovery during the preceding calendar year.

The total assessed valuation is the sum of the assessed values for all properties in the county and is a measure of the tax base. The total assessed valuation for real and personal property in La Plata County is shown in Table 3–177. The total assessed valuation in La Plata County increased substantially between 1993 and 2000. Both production from existing oil and gas wells and construction of additional residential and commercial properties have contributed to the increase in the total assessed valuation of the county. Therefore, the tax base has increased since 1993.

**Table 3–177 Share of Total Assessed Value Attributable to Oil and Gas in La Plata County, 1993–2000**

| Year | Total Assessed Valuation ($) | Oil and Gas Portion ($) | Share From Oil and Gas |
|---|---|---|---|
| 1993 | 516,832,600 | 164,736,070 | 31.87% |
| 1994 | 624,804,060 | 239,470,550 | 38.33% |
| 1995 | 752,063,090 | 302,840,090 | 40.27% |
| 1996 | 706,256,580 | 241,082,400 | 34.14% |
| 1997 | 918,132,090 | 368,385,670 | 40.12% |
| 1998 | 1,125,640,730 | 561,742,810 | 49.90% |
| 1999 | 1,163,142,350 | 527,451,100 | 45.35% |
| 2000 | 1,211,254,190 | 554,475,990 | 45.78% |

Source: BBC 2001a

Oil and gas properties account for a substantial portion of the county tax base in La Plata County. Table 3–177 shows the total assessed valuation compared with the valuation of all oil and gas properties and the portion of the tax base attributable to oil and gas properties. The assessed valuation for all oil and gas properties has consistently exceeded 30 percent of the total in La Plata County and, more recently, has ranged between 40 and 50 percent.

Most of the assessed valuation that is attributable to oil and gas properties in La Plata County is from production of natural gas. As shown in Table 3–178, the assessed value of natural-gas production and equipment has represented at least 99 percent of the total assessed valuation for minerals in La Plata County for each year since 1994.

**Table 3–178 Share of Total Mineral Assessment Attributable to Natural Gas in La Plata County, 1993-2000**

| Year | Total Oil ($) | Total Gas ($) | Total Coal and Minerals ($) | Total Mineral Value ($) | Share Gas (percent) |
|---|---|---|---|---|---|
| 1993 | 1,068,460 | 102,992,210 | 427,170 | 104,487,840 | 98.57% |
| 1994 | 807,800 | 171,012,960 | 316,090 | 172,136,850 | 99.35% |
| 1995 | 766,970 | 215,821,520 | 276,690 | 216,865,180 | 99.52% |
| 1996 | 853,430 | 153,872,520 | 279,860 | 155,005,810 | 99.27% |
| 1997 | 1,392,480 | 366,993,190 | 552,480 | 368,938,150 | 99.47% |
| 1998 | 1,108,390 | 560,394,800 | 788,460 | 562,291,650 | 99.66% |
| 1999 | 733,160 | 522,723,310 | 994,800 | 524,451,270 | 99.67% |
| 2000 | 890,480 | 548,775,030 | 1,270,920 | 550,936,430 | 99.61% |

Source: BBC 2001a

### 3.16.2.4.2 Ad Valorem Property Taxes

Property tax collections represent a significant portion of total annual revenues for both La Plata and Archuleta Counties. The total assessed valuation, total property tax revenues, and total county revenues for La Plata County are shown in Table 3–177. As shown in the table, revenues from property taxes have represented between 22 and 35 percent of total annual revenues to the county since 1993.

**Table 3–179 Total Property Assessments, Taxes Levied, and Share of Total La Plata County Revenues, 1993-2000**

| Year | Total Assessed Valuation ($000s) | Mill Levy | Property Tax Revenues ($) | La Plata County Total Revenues[1] ($) | Property Tax Revenue Share |
|---|---|---|---|---|---|
| 1993 | 516,833 | 8.5 | 4,393,077 | 19,343,957 | 22.71% |
| 1994 | 624,804 | 8.5 | 5,310,835 | 22,120,020 | 24.01% |
| 1995 | 752,063 | 8.5 | 6,392,536 | 23,042,472 | 27.74% |
| 1996 | 706,257 | 8.5 | 6,003,181 | 26,843,661 | 22.36% |
| 1997 | 918,132 | 8.5 | 7,804,123 | 25,203,767 | 30.96% |
| 1998 | 1,125,641 | 8.5 | 9,567,946 | 27,109,172 | 35.29% |
| 1999 | 1,163,142 | 8.5 | 9,886,710 | 31,869,527 | 31.02% |
| 2000 | 1,211,254 | 8.5 | 10,295,661 | 36,540,222 | 28.18% |

Source: CODOLA 2003b

Furthermore, as shown on Figure 3–74 for La Plata County, both total county revenues and total property taxes have generally increased from 1993 to 2000. In addition, both total property tax revenues and revenues from oil and gas have paralleled total county revenues in recent years.

The county levies *ad valorem* taxes for producing oil and gas properties, based on the assessed value of production in the preceding year, the number of facilities in the county, and the personal property tied to production (Hammer, Siler and George Associates 1990). The assessed value is multiplied by the mill levy to calculate the property taxes due each year. The mill levy in La Plata County has been constant at 8.5 over the past decade and is the fourth lowest mill levy of all the counties in Colorado (La Plata County 2002a). Therefore, increases in property tax revenues from 1985 to 2000 have resulted from increased total assessed valuation in the county. Both gas production from existing wells and construction of additional residential and commercial properties have contributed to the increase in assessed valuation for the county. In addition, property values have appreciated by an average of 6.9 percent per year over the last decade (BBC 2001b).

The total assessed valuation, total property taxes, and total county revenues for Archuleta County are shown in Table 3–180. As shown in the table, revenues from property taxes have represented between 24 and 31 percent of county's total revenues since 1993. In Archuleta County, the mill levy has varied since 1997, decreasing in recent years. The total assessed valuation has increased from 1994 to 2000. Therefore, both total county revenues and property tax revenues have increased over this period.

A large share of the total property tax revenues for both counties in recent years is from oil and gas property, and primarily from production of gas. Table 3–181 shows the property tax revenues from oil and gas in La Plata County as a percentage of total property tax revenues for the years 1989 to 2000. Tax revenues from oil and gas properties have also increased from 1989 to 2000. Revenues from oil and gas as a percentage of total property tax have increased from 11.8 percent in 1989 to 45.3 percent in 2000. The growth in revenues from oil and gas results from increases in the assessed valuation of all producing gas properties. Other important sources of county revenues include residential property taxes (between 22 and 28 percent of total county revenues) and taxes on commercial and industrial property (between 15 and 20 percent of total county revenues).

**Table 3–180 Total Assessed Valuation, Total Property Taxes, Total Archuleta County Revenues, and Share from Property Taxes**

| Year | Total Assessed Valuation ($000s) | Mill Levy | Property Tax Revenues ($) | Archuleta County Total Revenues ($) | Property Tax Revenue Share ($) |
|---|---|---|---|---|---|
| 1993 | 79,295 | 21.15 | 1,703,201 | 5,438,727 | 31.32 |
| 1994 | 76,706 | 21.15 | 1,631,136 | 5,825,447 | 28.00 |
| 1995 | 80,959 | 21.15 | 1,712,732 | 6,572,860 | 26.06 |
| 1996 | 86,313 | 21.15 | 1,839,067 | 7,067,284 | 26.02 |
| 1997 | 89,826 | 21.15 | 1,912,018 | 7,270,450 | 26.30 |
| 1998 | 114,592 | 18.03 | 2,050,226 | 8,105,384 | 25.29 |
| 1999 | 119,373 | 18.76 | 2,242,523 | 8,971,438 | 25.00 |
| 2000 | 149,901 | 16.97 | 2,534,834 | 10,638,866 | 23.83 |

Source: CODOLA 2003b

**Table 3–181 Percentage of Total La Plata County Property Tax Revenues Paid by the Oil and Gas Property Taxes**

| Year | Property Tax Revenue Share from Oil and Gas Industry (Percent) | Total Property Tax Revenues ($) | Property Taxes Paid by Oil and Gas Industry ($) |
|---|---|---|---|
| 1989 | 11.8 | 3,079,358 | 363,364 |
| 1990 | 14.6 | 3,126,858 | 456,521 |
| 1991 | 21.3 | 3,339,072 | 711,222 |
| 1992 | 26.8 | 3,728,324 | 999,191 |
| 1993 | 26.1 | 3,746,908 | 977,943 |
| 1994 | 31.9 | 4,414,226 | 1,408,138 |
| 1995 | 38.3 | 5,283,359 | 2,023,526 |
| 1996 | 40.3 | 6,263,075 | 2,524,019 |
| 1997 | 34.1 | 6,030,695 | 2,056,467 |
| 1998 | 40.1 | 7,773,789 | 3,117,289 |
| 1999 | 49.9 | 9,497,368 | 4,739,187 |
| 2000 | 45.3 | 9,948,011 | 4,506,449 |

Sources: CODOLA 2001b, Verheyden 2002

Table 3–182 compares the property tax rates (levies) for La Plata and Archuleta Counties and other tax jurisdictions with statewide averages. The tax rates for the counties are below statewide averages because of several factors, including the substantial revenues from both tourism sales taxes and property taxes on producing gas properties, depending on the jurisdiction. The property tax rate in

Archuleta County is also slightly below the average for counties in Colorado, although it is not as low as in La Plata County.

Table 3–182 **Comparative Property Tax Levies, 1990 and 2000**

| Entity | Total Levy in Millions of Dollars<br>1990 | 2000 |
|---|---|---|
| La Plata County | 8.574 | 8.500 |
| Archuleta County | 16.561 | 17.257 |
| Statewide Average for Counties | 19.291 | 18.499 |
| City of Durango | 2.618 | 2.507 |
| Town of Bayfield | 7.920 | 5.964 |
| Town of Ignacio | 4.816 | 3.370 |
| Statewide Average for Municipalities | 8.343 | 7.729 |
| Durango School District | 39.710 | 21.052 |
| Bayfield School District | 44.551 | 39.326 |
| Ignacio School District | 38.300 | 15.958 |
| Statewide Average for School Districts | 44.519 | 41.865 |

Source: BBC 2001a

The property tax levies in La Plata County are lower than the tax rates for most other Colorado counties. These property tax rates are lower in part because of the taxes contributed by the existing oil and gas development. The property tax revenues paid by the existing oil and gas facilities in La Plata County have offset the amount of property taxes required from individual taxpayers or other sources. Therefore, individual property owners in La Plata County have paid lower property taxes because of the increased taxes paid by the oil and gas industry.

Table 3–183 shows the estimated property taxes paid in 2001 to La Plata County and the local school district for both residential and commercial properties. This estimate was based on the tax rate for Durango School District 9R, where much of the proposed CBM development would occur. In 2001, the average market value for a typical single-family residential property was $193,000, and the average market value for a commercial property was $500,000 (La Plata County Energy Council 2002). Each single-family residence in the county would have paid an additional $578 and each commercial property owner an additional $3,947 (on average) in property taxes in 2001 to generate a comparable amount of revenue, without the taxes paid by oil and gas (La Plata County Energy Council 2002). Owners of other types of properties in the county also paid lower annual taxes because of the revenues paid by the oil and gas industry.

Table 3–183 **Impact of Oil and Gas Development and Production on Taxes Paid by Other La Plata County Taxpayers, 2001**

| | Single Family Residential at $193,000 | | Commercial Building at $500,000 | |
|---|---|---|---|---|
| | SD 9R – Operating | La Plata County | SD 9R – Operating | La Plata County |
| 2001 Taxes without Oil & Gas | $557 | $415 | $3,631 | $3,203 |
| 2001 Taxes with Oil & Gas | $214 | $160 | $1,654 | $1,233 |
| Tax Savings due to Oil & Gas | $343 | $255 | $1,977 | $1,970 |
| Combined Annual Savings | $598 | | $3,947 | |

Data sources: La Plata County Energy Council 2002

In addition to the taxes paid directly to La Plata County, the oil and gas industry has also paid significant revenues to the local school districts. Table 3–184 shows the taxes paid by the oil and gas industry from 1997 to 2002 by school district. The oil and gas industry has paid $61 million to the school districts in the Project Area since 1997 (Nuss 2003).

**Table 3–184 Oil and Gas Tax Revenues to School Districts in La Plata County**

| | Year | | | | | |
|---|---|---|---|---|---|---|
| School District | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
| *Durango* | | | | | | |
| Assessed Value (Million Dollars) | 258.1 | 403.2 | 419.7 | 442.0 | 787.1 | 840.3 |
| Mill Levy | 27.633 | 22.378 | 21.5 | 21.052 | 15.394 | 17.307 |
| Tax Collected (Million Dollars) | 7.1 | 9.0 | 9.0 | 9.3 | 12.1 | 14.5 |
| *Bayfield* | | | | | | |
| Assessed Value (Million Dollars) | 43.8 | 54.9 | 43.10 | 39.9 | 84.1 | 108.7 |
| Mill Levy | 39.942 | 37.582 | 38.766 | 39.326 | 28.847 | 18.008 |
| Taxes Collected (Million Dollars) | 1.7 | 2.1 | 1.7 | 1. 6 | 2.4 | 2.0 |
| *Ignacio* | | | | | | |
| Assessed Value (Million Dollars) | 66.6 | 98.3 | 67.0 | 75.1 | 164.2 | 197.0 |
| Mill Levy | 22.163 | 17.429 | 17.471 | 15.958 | 8.825 | 7.598 |
| Taxes Collected (Million Dollars) | 1.5 | 1.7 | 1.2 | 1.2 | 1.4 | 1.5 |
| Total to Schools (Million Dollars) | 10.3 | 12.8 | 11.9 | 12.1 | 15.9 | 18.0 |

Source: Nuss 2003

Property taxes from the existing oil and gas development have increased total county revenues in La Plata County. Some additional county expenditures have been required, however, because of oil and gas development. Figure 3–75 compares the total county revenues and total operating expenditures from 1985 to 2000 with the property tax revenues from oil and gas from 1989 to 2000. Both revenues and expenditures have increased since 1985. In addition, revenues from oil and gas property taxes have increased since 1989.

"Net revenues" are defined as total revenues minus total expenditures. Table 3–185 shows the net revenues for La Plata County, compared with the property tax revenues from oil and gas from 1989 to 2000. During this period, revenues from oil and gas property tax ranged from 2 to 15 percent of total county revenues. Table 3–185 also shows the net revenues with and without property taxes from oil and gas. As shown in this table, net revenues would have increased from 1989 to 2000 with or without property tax revenues from gas production.

**Table 3–185 La Plata County Net Revenues, 1985 - 2000, Compared with Property Tax Revenues from the Oil and Gas, 1989 – 2000**

| Year | Net Revenue ($) | Property Tax Revenue from Oil and Gas Industry ($) | Property Tax Revenue Share from Oil and Gas (Percent of Total Net Revenue) | Net Revenue Without Property Tax Revenues from Oil and Gas ($) |
|---|---|---|---|---|
| 1989 | 3,837,580 | 363,364 | 9.47 | 3,474,216 |
| 1990 | 5,138,469 | 456,521 | 8.88 | 4,681,948 |
| 1991 | 4,659,261 | 711,222 | 15.26 | 3,948,039 |
| 1992 | 5,393,122 | 999,191 | 18.53 | 4,393,931 |
| 1993 | 5,886,458 | 977,943 | 16.61 | 4,908,515 |
| 1994 | 7,324,919 | 1,408,138 | 19.22 | 5,916,781 |
| 1995 | 6,700,662 | 2,023,526 | 30.20 | 4,677,136 |
| 1996 | 8,501,190 | 2,524,019 | 29.69 | 5,977,171 |
| 1997 | 7,307,820 | 2,056,467 | 28.14 | 5,251,353 |
| 1998 | 9,326,012 | 3,117,289 | 33.43 | 6,208,723 |
| 1999 | 12,120,027 | 4,739,187 | 39.10 | 7,380,840 |
| 2000 | 13,289,020 | 4,506,449 | 33.91 | 8,782,571 |

Source: CODOLA 2003b

Net revenues have increased over recent years in part as a result of revenues contributed by the oil and gas industry and in part because the number of residential and commercial properties has increased. In addition, properties in the county have appreciated over this period. Therefore, increased property taxes have contributed to the positive net revenues shown in the graph. Figure 3–76 shows the net revenues in La Plata County from 1985 to 2000.

Net revenues in Archuleta County generally increased from 1993 to 2000. To date, taxes from gas production are a minor share of total county revenues, however. Twenty CBM wells are currently producing in Archuleta County (Anderson 2003). However, only four active CBM wells are in the Project Area (BBC 2001a). Therefore, the oil and gas industry contributes a smaller portion of the tax revenues in Archuleta County, compared with La Plata County. Net revenues would have increased in Archuleta County with or without property tax revenues from the existing CBM production. Table 3–186 shows the total county revenues, total operating expenditures, and net revenues for Archuleta County from 1993 to 2000.

**Table 3–186 Net Revenues in Archuleta County**

| Year | Total Revenues ($) | Total Operating Expenditures ($) | Net Revenue ($) |
|---|---|---|---|
| 1993 | 5,438,727 | 4,317,919 | 1,120,808 |
| 1994 | 5,825,447 | 4,560,995 | 1,264,452 |
| 1995 | 6,572,860 | 5,052,981 | 1,518,879 |
| 1996 | 7,067,284 | 5,145,638 | 1,871,646 |
| 1997 | 7,270,450 | 5,508,322 | 1,762,128 |
| 1998 | 8,105,384 | 6,074,746 | 2,030,638 |
| 1999 | 8,971,438 | 6,695,293 | 2,276,145 |
| 2000 | 10,638,866 | 7,438,245 | 3,200,621 |

Source: CODOLA 2003b

### 3.16.2.4.3 Revenues to the State and Severance Tax Distributions

The State of Colorado levies a severance tax against proceeds from the sale of various minerals produced in the state. Redistribution of severance taxes, administered by the Colorado Department of Local Affairs, is another important source of county revenue. State severance taxes are assessed at between 2 and 5 percent of gross income from gas production. A rate of 5 percent is currently used in La Plata County. However, revenues generally accrue only when production increases because producers are allowed to credit property tax payments against the severance tax. Severance taxes are offset by credits, and no revenues are collected during periods of declining production.

Revenues from severance taxes that that can be attributed to the oil and gas industry in Colorado have fluctuated widely from 1993 to 2000, bottoming out in 1995. Since then, the severance taxes from oil and gas, measured both in terms of total attributable and as a share of total collections, have increased dramatically. For the period 1993 to 2000, Table 3–187 shows the total net severance tax revenues to the state from oil and gas production and the share of total severance tax revenues from oil and gas.

**Table 3–187 Colorado Severance Tax Collections**

| Year | Severance Tax from Oil & Gas ($) | Share of Total Mineral Severance Tax from Oil and Gas (percent) |
|---|---|---|
| 1993 | 13,469,344 | 60.59 |
| 1994 | 6,479,541 | 42.74 |
| 1995 | 1,632,524 | 15.12 |
| 1996 | 7,555,496 | 50.92 |
| 1997 | 18,688,357 | 61.73 |
| 1998 | 19,756,058 | 66.43 |
| 1999 | 23,326,711 | 68.65 |
| 2000 | 24,640,683 | 77.13 |

Source: Colby 2001

Half of the total revenues collected from the state severance tax go to the State Trust Fund and half go to the Local Impact Fund. Monies in the State Trust Fund are divided equally between loans to the Colorado Water Conservation Board and support for the Colorado Department of Natural Resources. Monies in the Local Impact Fund are divided between Energy and Mineral Impact Assistance Grants (85 percent) and Direct Distributions to Local Governments (15 percent).

Counties and municipalities receive direct redistributions of severance tax revenues from the Department of Local Affairs based on the number of employees involved in oil and gas production and who reside in the local jurisdiction. As shown in Table 3–188, direct distributions of severance tax revenues to La Plata and Archuleta Counties and other jurisdictions in the Project Area have fluctuated greatly, but have increased overall since 1993. In 2000, La Plata County received $145,558 in severance taxes (Colby 2001), which represents only 0.4 percent of the total county revenues.

### 3.16.2.4.4 Energy and Mineral Impact Assistance Fund Grants

Both La Plata and Archuleta Counties also received revenues from grants available from the Colorado Energy and Mineral Impact Assistance Fund. These grants assist communities affected by the fluctuations in the energy and mineral industries in the state. Funds come from the state severance tax on energy and mineral production and from a portion of the state's share of rentals and royalties paid to the federal government. These funds are paid for leasing and production on land with federally owned minerals.

**Table 3–188 Severance Tax Direct Distributions to La Plata and Archuleta Counties and Other Jurisdictions**

| | La Plata County | | | | Archuleta County | |
|---|---|---|---|---|---|---|
| Year | La Plata ($) | Bayfield ($) | Durango ($) | Ignacio ($) | Archuleta ($) | Pagosa Springs ($) |
| 1993 | 43,335 | 10,834 | 14,773 | 10,833 | 0 | 0 |
| 1994 | 20,191 | 6,424 | 7,989 | 6,424 | 0 | 0 |
| 1995 | 35,167 | 9,608 | 16,133 | 1,373 | 0 | 0 |
| 1996 | 30,772 | 10,919 | 16,527 | 7,871 | 665 | 0 |
| 1997 | 56,081 | 45,237 | 57,072 | 31,234 | 2,800 | 2,800 |
| 1998 | 25,654 | 39,678 | 67,946 | 39,303 | 3,930 | 0 |
| 1999 | 135,847 | 32,258 | 39,873 | 12,130 | 7,581 | 0 |
| 2000 | 145,558 | 50,342 | 43,932 | 21,111 | 9,744 | 3,533 |

Source: Colby 2001

Between 1993 and 2000, La Plata County received $12.8 million in grant awards. The grants distributed to the county were used to address impacts of oil and gas development, including improvements of roads and bridges, school districts, fire protection districts, and other governmental entities (La Plata County Energy Council 2002). During this same period, Archuleta County received $1.4 million in grants. The grant funds distributed to La Plata and Archuleta Counties each year from 1993 to 2000 are listed in Table 3–189.

**Table 3–189 Energy Impact Assistance Grants to La Plata and Archuleta Counties**

| Year | La Plata County[1, 2] ($) | Archuleta County[1, 2] ($) |
|---|---|---|
| 1993 | 2,112,877 | 234,050 |
| 1994 | 1,169,744 | 300,770 |
| 1995 | 401,006 | 71,032 |
| 1996 | 666,027 | 96,027 |
| 1997 | 633,714 | 13,714 |
| 1998 | 1,343,180 | 67,655 |
| 1999 | 1,909,796 | 573,056 |
| 2000 | 4,614,692 | 43,556 |

Notes:

[1] Many grants are awarded to multi-county entities.

[2] County totals are calculated using an apportionment mechanism.

Source: Colby 2001

Other entities that are eligible to receive these grants and loans include municipalities, school districts, special districts, and other political subdivisions and state agencies. A sampling of the types of projects funded includes water and sewer improvements, road improvements, recreation centers, senior centers and other public facilities, and fire protection buildings and equipment. They also may be applied to local-government planning. Because these funds are distributed based on the applications received, annual amounts are not as directly related to production, as is the direct distribution of severance taxes. Although these grants can provide a significant source of revenue, the annual amount may fluctuate significantly from year to year.

#### *3.16.2.4.5 Distributions of Federal Mineral Royalties to Counties*

La Plata and Archuleta Counties receive revenues from redistribution of mineral rents and royalties from federal land in Colorado. The total distributions to La Plata and Archuleta Counties from 1985 to 2000 are shown on Table 3–190 for federal mineral leases and royalties in Colorado. The portion of these total revenues that is attributable to natural gas royalties is also shown on the table.

**Table 3–190 Federal Rent and Royalty Distributions to Colorado and Project Area Counties**

| Year | Colorado ($) | Percent Gas Royalty | La Plata County ($) | Percent Gas Royalty | Archuleta County ($) | Percent Gas Royalty |
|---|---|---|---|---|---|---|
| 1995 | 35,488,952 | Unavailable | 845,542 | 53% | 30,943 | 6% |
| 1996 | 34,563,025 | 17% | 489,067 | 76% | 37,578 | 4% |
| 1997 | 37,423,600 | 25% | 1,001,462 | 78% | 48,648 | 5% |
| 1998 | 43,297,268 | 21% | 913,265 | 87% | 49,848 | 30% |
| 1999 | 37,426,612 | 19% | 838,397 | 80% | 43,542 | 10% |
| 2000 | 42,320,322 | 23% | 1,295,664 | 79% | 60,232 | 64% |

Source: BBC 2001a

The Minerals Management Service of the U.S. Department of the Interior disburses portions of lease fees, bonuses, and royalties paid for production of minerals on land with federal mineral ownership. After administrative charges are deducted, 50 percent of mineral rents and royalties from federal land is returned to the state of origin. In Colorado, these funds are then redistributed among the county governments, the State School Fund, and the State Water Conservation Board. Portions of these funds are also returned to the State Department of Local Affairs to fund the grants available from the Energy and Mineral Impact Assistance program, discussed above.

Total distributions to Colorado have increased slightly from 1995 to 2000, while the share attributable to natural gas royalties has remained between 20 and 25 percent. In contrast, about 80 percent of the federal distributions to La Plata County is attributed to natural gas royalties. Although total federal distributions that originate from production in Archuleta County have increased during this same period, the share attributable to natural gas royalties has risen because of increases in CBM production.

### 3.16.2.4.6 Sales Tax Revenues

The county and municipal governments receive revenues from local sales taxes. The local sales tax rate is 2 percent in La Plata County and 4 percent in Archuleta County. As shown in Table 3–191, revenues from both retail sales and county property taxes increased from 1993 to 2000. Revenues from retail sales and county sales taxes grew by 58 percent in La Plata County and by 53 percent in Archuleta County.

**Table 3–191 Retail Sales and County Sales Tax Revenues in La Plata and Archuleta Counties**

| | La Plata County | | Archuleta County | |
|---|---|---|---|---|
| Year | Retail Sales ($000s) | Sales Tax Revenue ($000s) | Retail Sales ($000s) | Sales Tax Revenue ($000s)[1] |
| 1993 | 584,571 | 5,863 | 67,915 | 1,530 |
| 1994 | 640,133 | 6,556 | 76,274 | 1,839 |
| 1995 | 702,226 | 6,927 | 86,583 | 2,040 |
| 1996 | 758,798 | 7,156 | 102,147 | 2,270 |
| 1997 | 769,613 | 7,560 | 118,584 | 2,620 |
| 1998 | 831,822 | 7,931 | 139,989 | 2,950 |
| 1999 | 883,846 | 8,623 | 157,632 | 3,160 |
| 2000 | 929,099 | 9,011 | 169,966 | Unavailable |

Note:

[1] Archuleta County figures estimated using the ratio of county and state sales tax rates.

Source: BBC 2001a

### 3.16.2.4.7 Expenditures and Fiscal Indicators

In addition to contributing additional revenues, the oil and gas industry has also imposed demands on local government services and facilities, some requiring additional county expenditures. For example, local oil and gas industry employees and their families require services from local governments, principally La Plata County, the municipalities of Durango and Bayfield, and the school districts in Durango, Ignacio, and Bayfield.

Road-maintenance expenditures increase because of land development to accommodate population growth. In addition, vehicular traffic from existing oil and gas development has caused wear and tear on the local roads, primarily in La Plata County.

Expenditures for capital improvements in La Plata County increased by 6 percent per year from 1990 to 1995, compared with population growth of 4 percent per year over the same period. From 1995 to 2000, expenditures for capital improvements increased by 16 percent per year, compared with population growth of 2 percent per year. Expenditures in La Plata County for the years 1990, 1995, and 2000 are summarized in Table 3–192.

“Public works” includes the county road and bridge programs. Expenditures for public works are required to maintain and improve the network of roads in La Plata County. The county road network increased from 400 miles in 1990 to 690 miles in 2000. As shown in Table 3–192, county expenditures for public works also increased from 1990 to 2000. In 1990, such expenditures were 14 percent of the total county operating expenditures. For the year 2000, expenditures for public works increased to about 22 percent of the total operating expenditures of the county.

**Table 3–192 La Plata County Expenditures, 1990, 1995, and 2000**

| Parameter | 1990 ($) | 1995 ($) | 2000 ($) |
|---|---|---|---|
| General Government | 2,538,203 | 3,293,679 | 4,825,909 |
| Public Safety | 2,996,078 | 4,232,018 | 5,616,273 |
| Public Works | 1,675,640 | 2,756,246 | 5,000,812 |
| Health & Welfare | 3,066,742 | 3,166,854 | 4,153,871 |
| Auxiliary Services | 481,675 | 1,150,525 | 1,583,143 |
| Community Programs | 1,419,466 | 1,609,239 | 2,100,038 |
| Subtotal for Operating Expenditures | 12,177,804 | 16,208,561 | 23,280,046 |
| Capital Improvements | 3,402,702 | 4,618,250 | 9,863,624 |
| Debt Service | 782,081 | 822,011 | 1,397,741 |
| Total Expenditures | 16,362,587 | 21,648,822 | 34,541,411 |

Source: CODOLA 2003b

The La Plata County Comprehensive Traffic Study (Bechtolt Engineering 1999) identified $251 million in road improvements needed countywide by 2020, based on an analysis of the projected volume of traffic and existing safety concerns. The estimated costs by priority of need are summarized in Table 3–193.

**Table 3–193 Estimated Costs for Needed Improvements to La Plata County Roads**

| Priority | Costs (in Millions of 1999 Dollars) |
|---|---|
| Improvements Needed by 2001 | 50.3 |
| Improvements Needed by 2010 | 11.2 |
| Improvements Needed by 2020 | 134.5 |
| New Roads and Alignments Needed by 2020 | 55.0 |
| Total | 251.0 |

Source: Bechtolt Engineering 1999

Capital projects for roads and bridges are funded through the engineering and maintenance costs centers of the Road and Bridge Fund. The main categories of revenues and expenditures for road and bridge work in La Plata County for the years 1998 through 2000 are shown on Table 3–194.

From 1988 to 2000, property taxes provided 32 percent of road and bridge funds, on average. Sales taxes were 29 percent, and the highway-users tax 22 percent during the same period. Capital projects represented 41 percent of expenditures, on average, for the same period. In addition, La Plata County received a $2 million grant in the year 2000 from the Colorado Energy and Mineral Impact Assistance Fund.

The Public Safety Division of the Sheriff's Office handles traffic enforcement in unincorporated La Plata County and responds to calls for law enforcement, traffic control, and emergencies. As shown on Table 3–192, the portion of total county expenditures spent on public safety increased from 1990 to 2000. Expenditures for public safety represented 24 percent of total operating expenditures in 2000. The share of total operating expenditures for public safety is down, however, from 26 percent in 1995.

**Table 3–194 Sources and Uses of Road and Bridge Funds, 1998, 1999, and 2000**

| Funding Sources and Expenditures | 1998 ($) | 1999 ($) | 2000 ($) (estimate) |
|---|---|---|---|
| *Funding Source* | | | |
| Property Taxes | 3,904,981 | 3,084,371 | 2,490,469 |
| Highway Users Tax | 2,083,244 | 2,220,217 | 2,300,000 |
| Intergovernmental Revenues | 5,277,538 | 800,916 | 2,145,000 |
| Sales Taxes | 1,300,000 | 3,400,000 | 4,000,000 |
| Other Sources | 328,769 | 661,458 | 706,186 |
| Total | 8,144,532 | 10,166,962 | 11,641,655 |
| *Expenditures* | | | |
| Personnel | 1,879,617 | 2,004,229 | 2,291,554 |
| Operations | 3,918,642 | 3,463,763 | 2,720,483 |
| Capital Projects | 249,810 | 3,772,664 | 7,435,311 |
| Total | 6,048,069 | 9,240,656 | 12,447,348 |

Source: BBC 2001a

The expenditures and sources of revenue for public safety from 1998 to 2000 for La Plata County are shown in Table 3–195. As shown in the table, most of the expenditures for public safety are allocated to personnel, primarily Sheriff's officers.

**Table 3–195 Funding for Public Safety in the La Plata County Sheriff's Office**

| Expenditures and Revenues | 1998 ($) | 1999 ($) | 2000 ($) (estimate) |
|---|---|---|---|
| *Expenditures* | | | |
| Total Expenditures | 1,867,845 | 2,123,827 | 1,889,193 |
| Personnel | 1,322,186 | 1,514,928 | 1,239,013 |
| *Revenues* | | | |
| Directly Generated by the Office | 238,600 | 285,085 | 219,747 |
| Balance Required from General Revenue | 1,629,245 | 1,838,741 | 1,669,446 |

Source: BBC 2001a

There are few oil and gas wells in Archuleta County. They are on federal land, and the oil and gas operator is responsible for maintenance of these roads. In addition, few employees of the oil and gas industry live in Archuleta County. Therefore, expenditures in Archuleta County have not increased as a result of oil and gas development.

### 3.16.2.5 Social Values, Quality of Life, and Tourism

The quality of life associated with a geographic location and the reasons people live there are subjective measures based on a variety of values. Some residents regard the oil and gas facilities in the Project Area as incompatible with the natural environment and the visual landscape. Many other people support oil and gas development, however, because of the positive economic effects.

Residents who own mineral as well as surface rights in the Project Area may support CBM development on the property for the direct benefit to their income. In contrast, landowners with no mineral ownership may view CBM development negatively.

Supporters of oil and gas development in southwestern Colorado, including some residents of La Plata County, generally view the industry as providing economic benefits. These include royalty payments, relatively high-paying jobs, and revenues to local government paid by the industry that support increased public services and lower taxes.

At the same time, some residents are concerned about the effects of gas development on the quality of life. These concerns typically include perceived effects related to air quality, water quality, visual appeal, noise levels, public safety, and land-use conflicts with residential properties.

Some residents have expressed concerns about effects from traffic related to CBM, such as noise, safety, and damage to rural roads from heavy trucks. In addition, landowners are worried about the safety of living near industrial facilities and flammable or hazardous materials.

Some residents are concerned that CBM development may reduce the number of visitors to the area and affect the tourism industry. The quality of the natural environment, the visual landscape, and the recreational opportunities in the region attract many visitors. Tourism is a major employment sector in the region. To date, however, gas development has not noticeably affected tourism in La Plata County (BLM et al. 2002).

### 3.16.2.6 Property Values

Some residents have expressed concern that CBM development has reduced property values in the Project Area. In some cases, CBM wells near private homes have created land-use conflicts between the industry and landowners. Primarily, landowners who do not own the mineral rights for their properties are concerned. These concerns involve the need to negotiate surface-use agreements, the cost of reaching agreements with mineral producers, the perception that landowners risk uncompensated damage, and the perceived need to monitor industry compliance with regulatory requirements. In addition, the sights, sounds, and vehicular traffic of CBM development have affected some landowners.

Private landowners are interested in estimating nearby CBM wells' actual effects on the market value of residential properties. The assessed value assigned to the property for taxes is based on market value. The La Plata County Assessor does not routinely adjust property values based on the presence of a nearby CBM well.

## 3.16.3 Environmental Consequences

This section analyzes the proposed project's potential effects on social and economic values. We analyzed these effects for three geographical areas: La Plata County, Archuleta County, and the NSJB regional impact area. The NSJB region is defined as La Plata, Archuleta, and Montezuma Counties in Colorado and San Juan County in New Mexico.

IMPLAN is a computer-based system used to estimate economic impacts as part of the NEPA process. Table 3–196 summarizes the total economic impacts derived from the IMPLAN model for the proposed project for all the alternatives (BBC 2002). The impacts are presented on an annual basis for each of the three geographic-impact areas and for two separate periods during the life of the project: field development, and peak production. The period of field development for any of the alternatives was assumed to begin in 2003 and to last for 5 years. With the exception of the No Action Alternative (Alternative 5), the peak production year was projected to be 2011 for all the alternatives. The average production period for a CBM well was estimated to be 30 years for the IMPLAN model.

**Table 3–196 Summary of the Total Economic Impacts per Year during Field Development and Peak Production, by Alternative**

| | Output (million $) | | | Employment (no. of jobs) | | | Personal Income (million $) | | |
|---|---|---|---|---|---|---|---|---|---|
| Alternative/Phase[1] | La Plata County | Archuleta County | Northern San Juan Region | La Plata County | Archuleta County | Northern San Juan Region | La Plata County | Archuleta County | Northern San Juan Region |
| *Alternative 1* | | | | | | | | | |
| Field Dev. | 48.9 | 42.6 | 160.2 | 350 | 275 | 1,435 | 28.4 | 25.3 | 86.0 |
| Peak Prod. | 102.4 | 107.1 | 221.5 | 460 | 455 | 1,120 | 45.1 | 43.3 | 98.3 |
| *Alternative 1A* | | | | | | | | | |
| Field Dev. | 48.9 | 42.6 | 160.2 | 350 | 275 | 1,435 | 28.4 | 25.3 | 86.0 |
| Peak Prod. | 102.4 | 107.1 | 221.5 | 460 | 455 | 1,120 | 45.1 | 43.3 | 98.3 |
| *Alternative 1B* | | | | | | | | | |
| Field Dev. | 48.9 | 42.6 | 160.2 | 350 | 275 | 1,435 | 28.4 | 25.3 | 86.0 |
| Peak Prod. | 102.4 | 107.1 | 221.5 | 460 | 455 | 1,120 | 45.1 | 43.3 | 98.3 |
| *Alternative 2* | | | | | | | | | |
| Field Dev. | 103.2 | 57.9 | 270.0 | 715 | 380 | 2,395 | 60.3 | 34.3 | 146.2 |
| Peak Prod. | 227.9 | 144.7 | 390.6 | 1,020 | 610 | 1,975 | 100.3 | 58.6 | 173.3 |
| *Alternative 3* | | | | | | | | | |
| Field Dev. | 46.0 | 20.4 | 115.5 | 320 | 135 | 1,035 | 26.8 | 12.1 | 61.7 |
| Peak Prod. | 101.6 | 50.3 | 158.6 | 455 | 215 | 800 | 44.7 | 20.4 | 73.0 |
| *Alternative 4* | | | | | | | | | |
| Field Dev. | 44.3 | 15.0 | 103.0 | 300 | 100 | 925 | 26.0 | 8.9 | 55.2 |
| Peak Prod. | 98.8 | 36.5 | 140.7 | 445 | 155 | 710 | 43.5 | 14.8 | 62.4 |
| *Alternative 5* | | | | | | | | | |
| Field Dev. | 31.6 | 5.4 | 60.7 | 210 | 35 | 535 | 18.6 | 3.2 | 32.8 |
| Peak Prod. | 73.0 | 12.7 | 88.3 | 325 | 55 | 445 | 32.2 | 5.1 | 39.2 |

Note:

[1] Field Dev. = Field Development, Peak Prod. = Peak Production (2013).

Source: BBC 2002

The results of the IMPLAN model are expressed in terms of effects on output, employment, and personal income. "Output" is defined as the total economic impacts and is the sum of direct and secondary (indirect and induced) economic impacts measured in 2002 dollars. "Direct economic effects" are defined as the value of goods and services sold by industry, including the value of gas production. "Indirect" effects were calculated by applying IMPLAN multipliers to the direct effects and include secondary economic effects on the service industry and retailers from project employee spending. "Employment" is defined as the total number of jobs, including direct industry employment and supporting jobs. "Personal income" includes the sum of income from project-employee salaries and other income measures defined in the IMPLAN model, such as income to some local residents from private mineral royalties (BBC 2002).

The number of jobs increased between 1990 and 2000 in both La Plata and Archuleta Counties. Even without additional CBM development, the number of jobs in both counties is projected to increase from 2000 to 2025 because of continued economic expansion. The projected employment shown in Table 3–197 was considered the benchmark (baseline) number of jobs before additional CBM development begins. The existing number of jobs in 1990 and 2000, and the projected number of jobs in 2010 and 2025, are shown in Table 3–197 for both La Plata and Archuleta Counties.

**Table 3–197 Employment Trends and Projections to 2025, La Plata and Archuleta Counties**

| County | 1990 | 2000 | 2010 | 2025 |
|---|---|---|---|---|
| La Plata County | 19,191 | 30,811 | 40,993 | 53,803 |
| Archuleta County | 2,724 | 5,222 | 7,097 | 9,283 |

Source: BBC 2002

The differences among the benchmark number of jobs, the projected population, and the peak project-related employment were used to analyze the potential effects on population, employment, earnings and income, housing, and county facilities, services, and infrastructure. For the year 2010, the projected total number of new jobs (Table 3–197) and the projected total population in both counties (Table 3–162) are summarized in Table 3–198. We compared these projected numbers with the estimated employment at peak production for each alternative, as shown in Table 3–196. As shown in the table, "employment" includes jobs directly attributable to the CBM industry and jobs generated indirectly.

Under any alternative, effects would be minimal on the local population, employment, earnings and income, housing, or facilities, services and infrastructure in La Plata or Archuleta Counties or the NSJB region. Effects on employment and income would be small, relative to the total number of jobs and associated income. The gas industry would, however, generate 380 to 1,630 well-paying jobs in the area. Employment at peak production for each alternative is compared with the benchmark employment in the year 2010, as shown in Table 3–198 for La Plata and Archuleta Counties together. There would be positive effects on local fiscal conditions and county revenues for any of the alternatives. These topics are summarized in the following subsections.

**Table 3–198 Number of Jobs and Portions of Total Projected Employment and Population in 2010 for La Plata and Archuleta Counties, by Alternative**

| Alternative | Total Number of New Jobs[1] | Number of Jobs as a Portion of Total Employment[2] (percent) | Number of Jobs as a Portion of Total Population[3] (percent) |
|---|---|---|---|
| 1 | 915 | 1.9 | 1.3 |
| 1A | 915 | 1.9 | 1.3 |
| 1B | 915 | 1.9 | 1.3 |
| 2 | 1,630 | 3.4 | 2.3 |
| 3 | 670 | 1.4 | 0.9 |
| 4 | 600 | 1.2 | 0.8 |
| 5 | 380 | 0.8 | 0.5 |

Notes:

1. The number of new jobs includes new jobs (direct and indirect) for the two counties
2. Projected total employment for La Plata and Archuleta Counties in 2010 is 48,090 (from Table 3–197).
3. Projected total population for La Plata and Archuleta Counties in 2010 is 70,761 (from Table 3–162).

## 3.16.3.1 Population

Under any of the alternatives, CBM development would contribute a small number of new residents, compared with the general population of La Plata and Archuleta Counties. The population in the Project Area has grown significantly over the past decade, and this growth is expected to continue, with or without additional CBM development.

### *3.16.3.1.1 Alternative 1—Proposed Action*

Implementation of Alternative 1 would result in a small influx of new employees who would migrate to the region. The total number of new employees required during peak production would represent a small increase in population, compared with the projected total population in the region. As shown in Table 3–198, the peak employment for this alternative would represent a 1 percent increase in population, compared with the total population of both La Plata and Archuleta Counties.

Most of the required number of employees for this alternative would already reside within daily commuting distance of the project. Many of the project employees would be expected to commute daily from Farmington, New Mexico, which is considered the regional center for the oil and gas industry (BLM et al. 2002). In addition, the number of employees in oil and gas extraction decreased between 1991 and 1999 for La Plata County (Table 3–170). Therefore, it is likely that many employees of the oil and gas industry would already live in the area and be available for work. Since few employees would be recruited from outside the region, only a small number of new residents would migrate into the region as a result of the project. Thus, there would be a small increase in population for this alternative and little or no effect on the demographics of the two counties or the NSJB region.

#### *3.16.3.1.2 Alternative 1A*

The effects on population and demographics for this alternative would be the same as Alternative 1's.

#### *3.16.3.1.3 Alternative 1B*

The effects on population and demographics for this alternative would be the same as Alternative 1's.

#### *3.16.3.1.4 Alternative 2*

With implementation of Alternative 2, there would be a small influx of new residents to the region because of project employment. The peak employment for this alternative would be larger, compared with the other alternatives. However, the peak employment for this alternative would represent a population increase of 2 percent, compared with the total population in both La Plata and Archuleta Counties. The majority of the project workers would come from the NSJB region, and a small number of workers would migrate into the region. Thus, effects on population and demographics would be similar to Alternative 1's.

#### *3.16.3.1.5 Alternative 3*

The effects on population and demographics for this alternative would be similar to Alternative 1's.

#### *3.16.3.1.6 Alternative 4*

The effects on population and demographics for this alternative would be similar to Alternative 1's.

#### *3.16.3.1.7 Alternative 5—No Action*

Under implementation of Alternative 5, the total number of employees would be smaller than with the other alternatives. It is unlikely that an influx of new residents to the NSJB region would be associated with this alternative. Therefore, there would be little or no effects on population or demographics.

### 3.16.3.2 Employment

There would be a small increase in employment in the region under each of the alternatives. The new employment associated with each of the alternatives is shown in Table 3–196, and the employment at peak production is compared with the projected benchmark employment in Table 3–198. Employment over the life of the project would represent a small increase compared with the total employment in the region.

#### *3.16.3.2.1 Alternative 1—Proposed Action*

Under implementation of Alternative 1, there would be a small increase in employment, compared with the total projected employment in La Plata and Archuleta Counties. As shown in Table 3–198, the employment at peak production for this alternative would represent an increase of less than 2 percent, compared with the total employment in both counties. There would be a small increase in total employment in the two counties or the NSJB region for this alternative.

#### 3.16.3.2.2 Alternative 1A

The effects on employment for this alternative would be the same as Alternative 1's.

#### 3.16.3.2.3 Alternative B

The effects on employment for this alternative would be the same as Alternative 1's.

#### 3.16.3.2.4 Alternative 2

As shown in Table 3–198, employment at peak production under Alternative 2 would be more extensive, compared with the other alternatives. However, the employment at peak production for this alternative would represent an increase of only 3 percent, compared with the total employment in La Plata and Archuleta Counties. There would be a small increase in total employment in the two counties or the NSJB region for this alternative.

#### 3.16.3.2.5 Alternative 3

The effects on total employment in the region for this alternative would be similar to Alternative 1's.

#### 3.16.3.2.6 Alternative 4

The effects on total employment in the region for this alternative would be similar to Alternative 1's.

#### 3.16.3.2.7 Alternative 5—No Action

Under Alternative 5, the total employment at peak production would be less, compared with the other alternatives. However, the effects on total employment in the region would be similar to Alternative 1's.

### 3.16.3.3 Earnings and Income

Implementation of any of the alternatives would have a small effect on earnings and income, compared with the total earnings and income in La Plata and Archuleta Counties. As shown in Table 3–198, employment at peak production generated by CBM development for any of the alternatives would represent a small percent of the total employment in the region. There would be little or no change in the earnings or per capita income in the region, because of the relatively small number of jobs created by CBM development, directly and indirectly, compared with total employment and income in the region.

#### 3.16.3.3.1 Alternative 1—Proposed Action

Under Alternative 1, there would be a small increase in earnings or income in La Plata or Archuleta Counties and the NSJB region. As shown in Table 3–198, employment at peak production for this alternative would represent 2 percent of the total employment in the region. Jobs in the oil and gas industry are generally higher paying, however, relative to other employment sectors. For example, the existing jobs in the oil and gas sector represent less than 1 percent of the total employment in La Plata County, but these higher-paying jobs generate about 2.5 percent of the direct basic income of the county (CODOLA 2002b). In addition, most of the project-related income from employment would be spent in the NSJB region, of which 48 percent of the disposable income of the project-related employees would be spent in La Plata County (BBC 2002).

In addition to salaries, private mineral royalties from CBM production would be paid to some local residents who own minerals. This income would also be a component of personal income that would result from the proposed project. Local residents who own minerals would receive direct royalty payments from the companies: private royalties are paid at a rate of 12.5 percent of total production income. Both income from private royalties and secondary economic impacts from personal consumption spent locally are included as personal income in Table 3–196. Income from private royalties would be a small portion of the total personal income that would result from the proposed project (BBC 2002).

The number of jobs and the associated earnings and personal income from salaries would be small, compared with total employment and income in the region for this alternative. Therefore, there would be a small increase in earnings or average per capita income in the two counties or the NSJB region.

#### *3.16.3.3.2 Alternative 1A*

The effects on earnings and per capita income for this alternative would be the same as Alternative 1's.

#### *3.16.3.3.3 Alternative 1B*

The effects on earnings and per capita income for this alternative would be the same as Alternative 1's.

#### *3.16.3.3.4 Alternative 2*

Under Alternative 2, there would be more project-related employees, compared with the other alternatives. Therefore, additional earnings and personal income would be associated with salaries. The effects on earnings and per capita income in the region would, however, be similar to Alternative 1's effects.

#### *3.16.3.3.5 Alternative 3*

The effects on earnings and per capita income for this alternative and would be similar to Alternative 1's.

#### *3.16.3.3.6 Alternative 4*

The effects on earnings and per capita income for this alternative would be similar to Alternative 1's.

#### *3.16.3.3.7 Alternative 5—No Action*

Under Alternative 5, there would be fewer project-related employees, compared with the other alternatives. Therefore, there would be less earnings and personal income from salaries, compared with the other alternatives. However, the effects on earnings and per capita income would be similar to Alternative 1's.

### 3.16.3.4 Housing

There would be a small increase in the demand for local housing under any of the alternatives, and, therefore, a minor effect on the availability of housing. As shown in Table 3–198, the total number of CBM employees would represent a small increase in population, compared with the total population or total available housing units in both La Plata and Archuleta Counties. In addition, most project-related workers are expected to be local residents who already live within commuting distance of the project. Therefore, the proposed project would result in a minor increase in demand for local housing in the region.

#### 3.16.3.4.1 Alternative 1—Proposed Action

Implementation of Alternative 1 would result in a small increase in demand for local housing in both La Plata and Archuleta Counties. Employment at peak production for Alternative 1 would require 915 workers. Most of these employees already reside within commuting distance of the project, and, therefore, would not affect demand for housing. As shown in Table 3–174 and Table 3–175, more than 6,600 vacant housing units were available in both counties in 1999. In addition, projections by the county planning departments indicate that additional housing would be available by the peak in production of the proposed project (year 2013). Thus, there would be a small increase in demand on the local housing market and little or no effect on the availability of housing in the two counties or the NSJB region.

#### 3.16.3.4.2 Alternative 1A

The effects on the local housing market or on availability of housing in the region for this alternative would be the same as for Alternative 1.

#### 3.16.3.4.3 Alternative 1B

The effects on the local housing market or on availability of housing in the region for this alternative would be the same as for Alternative 1.

#### 3.16.3.4.4 Alternative 2

Under Alternative 2, employment at peak production would be larger, compared with the other alternatives; however, the effects on the local housing market or availability of housing would be similar to Alternative 1's effects.

#### 3.16.3.4.5 Alternative 3

The effects on the local housing market or availability of housing for this alternative would be similar to Alternative 1's.

#### 3.16.3.4.6 Alternative 4

The effects on the local housing market or availability of housing for this alternative would be similar to Alternative 1's.

#### 3.16.3.4.7 Alternative 5—No Action

The total employment required would be smaller, compared with the other alternatives. However, the effects on the local housing market or availability of housing would be similar to Alternative 1's.

### 3.16.3.5 County Facilities, Services, and Infrastructure

"County facilities, services, and infrastructure" are defined as law enforcement, education (schools), fire and emergency response services, hospitals, and utilities. There would be a small influx of new residents for the proposed project. Therefore, the proposed project would result in a small increase in demand for county facilities, services, or infrastructure. The potential effects of the additional project-related vehicular traffic associated with CBM development, including wear and tear on county and local roads and bridges, are analyzed in the section on Transportation.

#### 3.16.3.5.1 Alternative 1—Proposed Action

Under Alternative 1, a small influx of new residents would be associated with the proposed project. The majority of project-related employees would be current residents of the NSJB region. Therefore, the proposed project would have a small effect on law enforcement, schools, fire and emergency response services, and hospitals. Some additional county services would be required during construction, such as responses from fire or emergency personnel or review by planning staff of permit applications. Because few new residents would migrate into the region because of the project, however, there would be a small increase in demand for county facilities, services, or infrastructure.

The project would not involve utility and service requirements that directly affect capacity. The companies would purchase needed utilities (electric power or water) from existing sources, and the service provider would supply the capacity needed. No other utilities would be affected.

The financial benefits to the counties from the proposed project would greatly outweigh the costs of any additional county services that may be required. Additional CMB development would result in significant increases in property tax revenues, compared with current revenues for both counties. In addition, grants from the Colorado Energy and Mineral Impact Assistance Fund would be available to address impacts that would result from CBM development.

#### 3.16.3.5.2 Alternative 1A

The effects on county facilities, services, or infrastructure for this alternative would be the same as Alternative 1's.

#### 3.16.3.5.3 Alternative 1B

The effects on county facilities, services, or infrastructure for this alternative would be the same as Alternative 1's.

#### 3.16.3.5.4 Alternative 2

Under Alternative 2, the total peak employment would represent an increase of 2 percent, compared with the total population in both La Plata and Archuleta Counties, and would be larger, compared with the other alternatives. However, the majority of project-related employees would be current residents of the NSJB region. Thus, there would be few additional residents because of the project and a small related increase in demand for county facilities, services, or infrastructure.

#### 3.16.3.5.5 Alternative 3

Under Alternative 3, the effects on county facilities, services, or infrastructure would be similar to Alternative 1's.

#### 3.16.3.5.6 Alternative 4

Under Alternative 3, the effects on county facilities, services, or infrastructure would be similar to Alternative 1's.

#### 3.16.3.5.7 Alternative 5—No Action

Under implementation of Alternative 5, the total employment and influx of new residents would be smaller, compared with the other alternatives. However, the effects on county facilities, services, or infrastructure for this alternative would be similar to Alternative 1's.

## 3.16.3.6 Fiscal Conditions of Local Government

The impacts on the fiscal conditions of both La Plata and Archuleta Counties are discussed in this section. The proposed project would result in additional revenues to both counties from a variety of sources. The primary sources of revenue from the proposed project include the *ad valorem* property tax, redistribution of severance taxes collected on gas production, grants from the Colorado Energy and Mineral Impact Assistance Fund, distributions of federal mineral royalties, and collection of sales taxes derived from project-related purchasing in the counties. The following sections summarize the primary sources of revenues for both counties that would be generated by the proposed project.

#### 3.16.3.6.1 Alternative 1—Proposed Action

Under Alternative 1, both La Plata and Archuleta Counties would receive additional revenues from a variety of sources. Figure 3–77 shows the estimated average annual revenues to La Plata and Archuleta Counties from *ad valorem* property tax, severance tax, and both federal and state mineral royalties.

##### *Assessed Valuation*

Construction and operation of an additional 296 CBM wells in La Plata and Archuleta Counties would increase the total assessed valuation (tax base) by $81 million in current dollars. This rise in valuation would represent an increase of 6 percent, compared with the tax base of both counties for the year 2000. The assessed value of oil and gas properties in La Plata County has consistently exceeded 30 percent of the total assessed valuation in recent years. The assessed value of CBM gas production and field equipment would continue to be a significant portion of the total assessed valuation in both counties over the life of the project.

As production declined, the assessed value of gas properties would account for a declining share of the total tax base over the life of the project. There is a direct correlation between the level of gas production and assessed valuation for CBM wells. Therefore, assuming a constant price for natural gas, gas production and assessed valuation would peak during the first years of the project and then begin to decline. In reality, natural gas prices are not constant. Therefore, changes in gas prices may either exaggerate or minimize the effects on the tax base during declining production in the later years of the project.

The total assessed valuation for both counties would increase because of the growing numbers of residential and commercial properties, with or without additional CBM development. The residential and commercial valuation is likely to increase as a result of the projected population growth during the life of the project. In La Plata County, the assessed valuation is estimated to increase at an average rate of 2.5 percent per year; therefore, the total assessed valuation would increase to $985 million by the year 2010 (Hammer, Siler, George Associates

1997). The gas industry's share of the tax base would decline to a small percent of the total assessed valuation in La Plata County in the later years of the project.

### Ad Valorem Property Taxes

Under Alternative 1, *ad valorem* property taxes on production would generate additional revenues for both La Plata and Archuleta Counties. The property taxes on production would generate a combined total of $50.5 million of revenue for both counties over the life of the project.

Alternative 1 would result in a projected total of $33.1 million in property tax paid to La Plata County. The total *ad valorem* property taxes paid to La Plata County under Alternative 1 over the life of the project for each of the alternatives are shown on Figure 3–78.

Implementation of Alternative 1 would result in an average of $1.2 million in annual property taxes paid to La Plata County for the 30-year life of the project. The annual *ad valorem* property taxes that would be paid to La Plata County over the life of the project for each alternative are shown on Figure 3–77and Figure 3–79.

Under implementation of Alternative 1, a total of $17.4 million in property tax would be paid to Archuleta County. Figure 3–80 shows the total *ad valorem* property taxes that would be paid to Archuleta County for each of the alternatives over the life of the project.

Alternative 1 would result in an average of $600,000 in annual property taxes paid to Archuleta County over the 30-year life of the project. The annual *ad valorem* property taxes paid to Archuleta County under each of the alternatives over the 30-year life of the project are shown on Figure 3–77 and Figure 3–81.

County revenues from gas production would decline in the later years of the project. Property tax revenues from production would, therefore, account for a declining share of the total county revenues over the life of the project for both La Plata and Archuleta Counties. Property tax revenues from gas production were $4.5 million and total county revenues were $36.5 million for La Plata County in the year 2000. For Alternative 1, the county revenues from gas production would peak during the fifth or sixth year of production and then begin to decline as production waned, assuming a constant price for natural gas. In year 2011, property tax revenues from production would generate more than $6 million per year for La Plata Country. Over the long term, annual property tax revenues from production would decline to about $300,000 in the later years of the project.

Assuming the total county revenues per year remain constant at $36.5 million (the year 2000 level) over the next 30 years, taxes from gas production would represent 12 to 16 percent of the total county revenues in the early years of the project and a smaller portion during the later years. In reality, total county revenues would increase with population growth, and taxes on production are likely to represent less than 1 percent of the total county revenues at the end of the project.

### Revenues to the State Severance Tax Distributions

Under Alternative 1, the State of Colorado would receive $3.8 million in average annual royalties from state mineral leases, as shown on Figure 3–77. In addition, the State of Colorado levies a severance tax against the proceeds of the sale of various minerals produced in the state.

Revenue from the severance tax is divided evenly between the State Severance Tax Trust Fund and the Local Government Severance Tax Fund. The state fund is used to pay for a variety of natural-resource-related conservation programs throughout Colorado. The local-government fund, which is administered by the Colorado Department of Local Affairs, is used to provide grants and loans to cities and counties where mineral extraction occurs, to help pay for a variety of local facilities, services, and infrastructure. Thus, the proposed project would benefit residents of Colorado, as a whole, and residents of counties in the Project Area, in particular, through payment of severance taxes into these funds.

Redistribution of severance taxes, administered by the Colorado Department of Local Affairs, would be another important source of county revenue. Revenues from severance taxes would be redistributed to the counties and municipalities affected by CBM development. Because of Alternative 1, the counties and municipalities in the Project Area would likely receive direct redistributions of severance taxes at an estimated average of $340,000 per year.

### Energy and Mineral Impact Assistance Fund Grants

The county governments (and other entities) may apply for grants from the Energy and Mineral Impact Assistance Fund. These grants are awarded to assist communities affected by fluctuations in the energy and mineral industries in the state. Funds come from the state severance tax on energy and mineral production. They also are derived from a portion of the state's share of rentals and royalties paid to the federal government for leasing and production of minerals and mineral fuels on land with federally owned minerals. The counties and municipalities in the Project Area would be able to use these grants for various types of projects, such as improvements to water, sewer, and roads, recreation centers, senior centers and other public facilities, and fire protection buildings and equipment.

It is not possible to calculate a specific benefit that would be derived from grants in the Project Area because of the proposed project, because the amount of the annual grant is not directly related to production. The amount of the grant would likely fluctuate from year to year.

### Federal Mineral Royalty Distributions to Counties

Under Alternative 1, the project would generate substantial mineral-lease royalties for a variety of local, state, and federal government entities. As shown on Figure 3–77, preliminary estimates indicate that the proposed project would generate an annual average of $6.9 million in federal mineral royalties. Half of this revenue would be paid to the federal government. The other half would be paid to the State of Colorado and would be distributed according to a complex formula to various state and local governments.

The entities that would receive revenues would include La Plata and Archuleta Counties, individual municipalities in the counties, the State School Fund, the Colorado Department of Local Affairs, and the Colorado Water Conservation Board. In each county, federal mineral royalty payments would be divided among the county governments, local school districts, and local municipalities. Portions of these funds are also returned to the State Department of Local Affairs to fund the Energy Impact Assistance Grants program discussed previously.

#### *Sales Tax Revenues*

Under Alternative 1, most of the project-related purchases would be made outside of the Project Area. The results of the IMPLAN analysis suggest that approximately 98 percent of project-related expenditures would occur outside La Plata and Archuleta Counties (BBC 2002). Therefore, project-related purchasing and spending would result in a small amount of revenue to the counties from sales taxes.

The project would result in additional indirect payment of sales taxes as a result of purchases by employees, who would spend their earnings on a wide variety of goods and services provided by businesses in local communities. However, minimal additional revenues from sales taxes would be collected in La Plata and Archuleta Counties, because the majority of the CBM-related purchasing would occur outside of the Project Area.

### *3.16.3.6.2 Alternative 1A*

The effects related to the fiscal condition of local government and county tax revenues for this alternative would be the same as Alternative 1's.

### *3.16.3.6.3 Alternative 1B*

The effects related to the fiscal condition of local government and county tax revenues for this alternative would be the same as Alternative 1's.

### *3.16.3.6.4 Alternative 2*

Alternative 2 would result in substantial increases in tax revenue and royalty collections from CBM development, compared with the current county revenues, as summarized in Figure 3–82. The increases in assessed value, property tax revenues to both counties, severance tax paid to the state, federal mineral royalties, and sales tax would all be more than 50 percent larger than the levels associated with Alternative 1. *Ad valorem* property taxes would be the primary direct source of increased revenues for both La Plata and Archuleta Counties. Over the life of the project, the property taxes on production would generate a combined total of $97 million of additional revenue for both La Plata and Archuleta Counties.

Alternative 2 would result in a total of $73.5 million in *ad valorem* property tax that would be paid to La Plata County, as shown in Figure 3–78. The annual *ad valorem* property taxes would result in an average of $2.7 million paid to La Plata County over the 30-year life of the project (Figure 3–82).

The total *ad valorem* property taxes that would be paid to Archuleta County under Alternative 2 would be $23.5 million, as shown in Figure 3–81. The annual *ad valorem* property taxes paid to Archuleta County under Alternative 2 would result in an average of $800,000 over the 30-year life of the project (Figure 3–82).

Property tax revenues from production would account for a declining share of total revenues for both La Plata and Archuleta Counties over the life of the project. As shown in Figure 3–79 and Figure 3–81, annual property tax revenues from production would decline to about $500,000 in the later years of the project.

Assuming the total county revenues per year remain constant at the year 2000 revenue level over the next 30 years, revenues from gas production would represent a small percent of the total paid to the county in the later years of the project. In reality, total county revenues would increase with population growth, and taxes on production are likely to represent less than 2 percent of the total paid to the county at the end of the production period.

#### *3.16.3.6.5 Alternative 3*

Alternative 3 would result in increased average annual tax revenue and royalty collections from CBM development, compared with current county revenues, as summarized on Figure 3–83. The increases in assessed value, property tax revenue, severance taxes paid to the State of Colorado, federal mineral royalties, and sales taxes would all be about 30 percent less than the levels associated with Alternative 1. As shown in Figure 3–78 and Figure 3–81, the property taxes on production would generate a combined total of $40.9 million of additional revenue for both La Plata and Archuleta Counties.

#### *3.16.3.6.6 Alternative 4*

Alternative 4 would result in increased tax revenue and royalty collections from CBM development, compared with current county revenues, as summarized on Figure 3–84. The increases in assessed value, property tax revenue, severance taxes paid to the State of Colorado, federal mineral royalties, and sales taxes would all be 35 percent less than the levels associated with Alternative 1. As shown in Figure 3–78 and Figure 3–81, the property taxes on production would generate a combined total of $37.7 million of additional revenue for both La Plata and Archuleta Counties.

#### *3.16.3.6.7 Alternative 5—No Action*

Alternative 5 (No Action) would result in increased tax revenue and royalties collected from CBM development, compared with current county revenues, as summarized on Figure 3–85. These revenues would, however, be considerably less than would be realized with the other alternatives. As shown in Figure 3–78 and Figure 3–81, the property taxes on production would generate a combined total of $25.6 million of additional revenue for both La Plata and Archuleta Counties.

The increases in assessed value, property tax revenue, severance taxes paid to the State of Colorado, federal mineral royalties, and sales taxes would all be 60 percent less than the levels associated with Alternative 1.

### 3.16.3.7 Impacts from Eventual Decline in Gas Revenues and Boom-and-Bust Cycle

The proposed project is unlikely to result in a significant economic boom-and-bust cycle. There would be a small reduction in employment at the end of the project, compared with the total employment in the region. The primary consideration for the analysis of boom-and-bust effects would be the eventual decline in production-related revenues in the later years of the project.

#### *3.16.3.7.1 Alternative 1—Proposed Action*

Implementation of Alternative 1 is unlikely to result in a significant boom-and-bust cycle in La Plata and Archuleta Counties. Employment and county revenues from production are analyzed to assess the potential for a boom-and-bust cycle. The project-related employment in the two counties in the Project Area would decline in the later years of the project. However, the total project-related employment would represent less than 2 percent of the direct basic employment in the region. In addition, the project-related employment and associated spending in the region would begin and end in a gradual manner over the 30-year production period.

There is a direct correlation for properties with CBM wells between the level of gas production and the amount of revenues paid to the counties. Gas production for this alternative would peak in the year 2011 and then decline gradually until the year 2037 or the end of the production period for the CBM wells. As production declined in the later years of the project, production-related revenues paid to both La Plata and Archuleta Counties would decline. The county revenues that are directly or indirectly related to production include property taxes, severance tax distributions and grants from the State of Colorado, and federal mineral royalties redistributed to the counties. *Ad valorem* property taxes on gas production would be the most significant revenues to the county governments.

The projected production curve for the new CBM wells under Alternative 1 was analyzed in the IMPLAN model (BBC 2002) and is shown in Figure 3–86. This curve is considered typical of the production pattern for any of the project alternatives and illustrates how production from the existing CBM wells declines over time. The IMPLAN model assumed that production for the new CBM wells would begin in 2003 and peak in the year 2011. Assuming that no new development would occur, production would decline gradually over time and eventually would end. Abandonment would occur in about 2037, assuming an average 30-year production period for the new wells.

County revenues from gas production would decline in the later years of the project in a manner similar to the production curve shown in Figure 3–86. We estimated the annual aggregate production values using projected production rates used in the IMPLAN model runs and applying a constant price of $2.06 per MCF, which was the 1999 gas price for the NSJB and is the projected average price until the year 2010 (BBC 2002, COGCC 2000b).

The reduction in production-related revenues during the later years of the project would have minor to moderately detrimental effects on the budgets of La Plata and Archuleta Counties. The effects of declining production on the local tax bases of La Plata and Archuleta Counties would be affected by future gas prices. Therefore, predicting the production-related revenues to the counties for the life of the project is highly speculative. However, using a constant 1999 price for gas, the oil and gas industry's share of La Plata County's property tax base is estimated to decline to a small percent of total county revenues during the later years of the production period.

Property taxes in the counties support the schools, county government, and services. Therefore, the budgets of the two counties would be affected as production-related tax revenues decline in the later years of the project. Additional revenues from CBM production would allow the counties to operate at a higher level of service than would be possible when revenues decline, unless the additional revenues were received from other sources. Alternative sources of revenue would be needed to support county services as production-related property tax revenues decline.

The population and employment in both La Plata and Archuleta Counties are projected to continue to grow, however, with or without CBM development. Construction of additional residential and commercial properties, to accommodate the projected growth in population, would increase the total assessed valuation for both counties. In addition, property values are expected to continue to appreciate at a rate of 6.9 percent per year (BBC 2002). Thus, the total assessed valuation and property tax revenues would increase over the life of the project, even without production. By the year 2010, the total assessed valuation of La Plata County is estimated to increase to more than $950 million (Hammer, Siler, George Associates 1997). Therefore, additional property taxes from new properties and appreciation of existing properties would increase total county revenues over time, with or without CBM development.

However, increases in population and growth in the number of residential and commercial properties would also increase expenditures for county services. "Net revenues" are defined as total county revenues minus total operating expenditures. Net revenues in both counties have been positive since 1994, and net revenues are expected to continue to increase over the life of the project. The counties may be able to direct funds toward future years when tax collections from oil and gas are anticipated to decline, if revenues continue to outpace expenditures.

For this alternative, production-related revenues to the counties would begin and end gradually over the 30-year production period. The county governments would have some time to develop strategies for obtaining other sources of revenue, because the decline in production would be gradual. La Plata County has defined several strategies to minimize the impacts of reduced revenues as production declines. Because of the revenues contributed by the oil and gas industry, the La Plata County mill levy of 8.5 has been constant since 1992, one of the lowest in the state. It is possible that the county mill levy would be increased, to offset the loss of production-related revenues at the end of the project. Colorado statutes limit increases in the county mill levy on residential properties, however, to 5 percent per year. The preferred strategy is to maintain property tax levies at or near current levels, rather than allow tax rates to decline as the total assessed valuation increases from additional CBM development (Hammer, Siler, George Associates 1997).

The portion of total county revenues derived from production-related revenues would decrease as the county tax base increases over time. In addition, net revenues for both counties increased from 1993 to 2001 and are expected to continue to grow over the life of the project. As revenues outpace expenditures, the counties may be able to direct funds toward future years, when tax collections from oil and gas are anticipated to decline. Long-term economic growth and diversification would likely somewhat offset the gradual decline in production-related revenues. It is probable that other sources of revenue would be available to the counties at the end of the project.

Overall, the proposed project would benefit net county revenues. The additional revenues that the counties would receive because of CBM development would greatly offset the adverse effects associated with the eventual decline in gas revenues.

#### 3.16.3.7.2 Alternative 1A

The effects of the eventual decline in county revenues and the potential for a boom-and-bust cycle would be the same as Alternative 1's.

#### 3.16.3.7.3 Alternative 1B

The effects of the eventual decline in county revenues and the potential for a boom-and-bust cycle would be the same as Alternative 1's.

#### 3.16.3.7.4 Alternative 2

Under Alternative 2, the potential effects of the eventual decline in employment and county revenues in the later years of the project would be larger, compared with the other alternatives. The effects on La Plata and Archuleta Counties related to a potential boom-and-bust cycle for this alternative would, however, be similar to Alternative 1's effects.

#### 3.16.3.7.5 Alternative 3

The effects of the eventual decline in gas revenues and the potential for a boom-and-bust cycle for this alternative would be similar to Alternative 1's.

#### 3.16.3.7.6 Alternative 4

The effects of the eventual decline in gas revenues and the potential for a boom-and-bust cycle for this alternative would be similar to Alternative 1's.

#### 3.16.3.7.7 Alternative 5—No Action

Production-related revenues would decline over time for this alternative as the production rates for the new CBM wells decrease. Additional sources for county revenues may be required at the end of the project.

### 3.16.3.8 County Expenditures

The proposed project would increase operating expenditures for both La Plata and Archuleta Counties. The additional revenues that the counties would receive because of additional CBM development, however, would greatly offset any increased expenditures that may be result from the project. Overall, the proposed project would benefit net county revenues.

### 3.16.3.8.1 Alternative 1—Proposed Action

Under Alternative 1, some operating expenditures for both La Plata and Archuleta Counties would increase as a result of the project. However, there would be little or no increase in county expenditures for the few new residents associated with the project. The majority of the project-related employees would be current residents of the NSJB region, and a small number of new residents would relocate to the area because of the project.

The proposed project would affect county expenditures for public works moderately, because of increased project-related traffic and transport of heavy equipment on local roads. The additional vehicular traffic associated with CBM development would increase wear and tear on some county and local roads and bridges, increasing maintenance costs to the counties. The effects of the project-related vehicular traffic, including wear and tear on county and local roads and bridges, are analyzed in the section on Transportation.

In addition to wear and tear on county roads, expenditures may increase for various county departments. For example, project-related traffic and construction may increase expenditures for public safety, such as law enforcement, traffic control, and emergency response. In addition, there would be an increased demand on some planning departments, such as for review of land-development-permit applications.

Overall, the proposed project would benefit net county revenues. The additional revenues the counties would receive because of CBM development would greatly offset the additional county expenditures that may be required.

### 3.16.3.8.2 Alternative 1A

The effects on county expenditures would be the same as Alternative 1's.

### 3.16.3.8.3 Alternative 1B

The effects on county expenditures would be the same as Alternative 1's.

### 3.16.3.8.4 Alternative 2

Under Alternative 2, the potential effects on county expenditures would be larger, compared with the other alternatives. Overall, the effects on county expenditures would be greatly offset by additional revenues to the counties.

### 3.16.3.8.5 Alternative 3

Under this alternative, the effects on county expenditures would be similar to Alternative 1's.

### 3.16.3.8.6 Alternative 4 Direction

Under this alternative, the effects on county expenditures would be similar to Alternative 1's.

### 3.16.3.8.7 Alternative 5—No Action

Under this alternative, there would be a smaller effect on county expenditures, compared with the other alternatives; the effects on county expenditures, however, would be similar to Alternative 1's.

### 3.16.3.9 Social Values, Quality of Life, and Tourism

Additional CBM development in the Project Area may affect social values, or subjective measures of the quality of life, depending on the locations of CBM facilities. These values would be affected on a case-by-case basis, and would depend on the perceptions of the individuals who are near the CBM facilities. Tourism is unlikely to be affected, however, by additional CBM development.

CBM development would create additional traffic on local roads for any of the alternatives. Traffic congestion and an increased risk of accidents may exist at some locations where CBM-related vehicles and equipment would enter and exit major roads. Noise, dust, and road damage would be associated with increased traffic and construction operations. Most of the potential effects related to social values, visual resources, recreational experience, and quality of life are addressed in more detail in resource-specific sections of the DEIS; therefore, these effects are only summarized in this section.

The CBM-related activities and facilities would change the visual appearance of some landscape areas for any of the alternatives. Overall, CBM development is not a prominent visual feature (La Plata County 2002b). Visual effects for an individual facility, however, are based on the type of site, distance from a point of observation, topography, vegetation, and landscaping.

Visual effects, noise, and dust generated during drilling, operation, and maintenance of the proposed CBM wells would be an annoyance for nearby residents and would affect the character of open space in some areas of the counties. New access roads and an increased level of activity in areas that are currently secluded and isolated would create conditions that some local residents would perceive as negative. These changes would alter the recreational experience in primitive or roadless areas.

Additional CBM development in the Project Area is unlikely to affect tourism. Tourism is a major employment sector in the region and is expected be continue to be an important source of revenues and income, with or without CBM development. Based on the increase in tourism-related employment (retail trade and services) in La Plata County from 1990 to 1999 (Table 3–167), gas development has not noticeably altered tourism. CBM development would continue to have minimal impacts on tourist attractions in the local area or region.

### 3.16.3.10 Property Values

Concern has been raised that CBM development may affect some private residential property values in the Project Area. The potential to affect both properties with CBM wells on them and properties near CBM wells on other lots is considered in this section.

It is difficult to measure the effect of any one parameter on property values with statistical validity, because of the numerous variables that affect them. Generally, residential property values are affected by the location of the property; the amount of land; the age, condition, and size of the residence; the type and quality of construction; the presence and condition of other structures on the property; and many other, less tangible, factors such as views, access, and proximity (or lack of) to services. In addition, the value of a residential property also depends on the subjective opinion of potential buyers.

Likewise, many variables associated with CBM development could influence the potential to affect property values. These variables include the location of new CBM facilities relative to residences, the surface and mineral ownership of the land affected, the land uses at these locations, and other factors.

The proposed CBM facilities would be on land with various ownership and land uses. The value would be affected differently depending on mineral ownership where wells would be on private property. Private property with wells falls into two categories of mineral ownership: (1) property where the surface is privately owned along with the minerals (private surface ownership and private mineral ownership), and (2) split-estate property (private surface ownership and federal mineral ownership).

In the case of property with both private surface ownership and private mineral ownership, the landowner would choose whether to allow a CBM well on the property. In these cases, the landowner would receive royalty payments from gas production if a well were developed, and would likely perceive a CBM well on the property as having a positive effect on the property value. Conversely, surface owners with no mineral ownership (split estate) do not have a choice about situating a well on the property. Therefore, they could consider a well as having a negative impact on property value, because they could see and hear it but would derive no revenue from it. Only a limited number of CBM facilities are proposed on split-estate residential properties.

The specific locations of CBM facilities on split-estate properties would usually be negotiated with landowners through the surface-use-agreement process. In cases where a surface use agreement is not successfully negotiated, however, the operator can go forward with a proposed CBM well without landowner approval. Surface owners are generally compensated for the value of land displaced by CBM facilities, in the form of damage payments from the operators. Damage payments to landowners are likely to offset some of the perceived reduction in value of a property where a CBM well is located. Compensation paid to surface owners may not be considered adequate, however, to offset removal of land from other uses or effects on property value.

Surface owners of split-estate properties would probably negotiate to place wells in less visible locations as part of the surface-agreement process, reducing the potential for effects on property value. Decisions on where to locate these CBM facilities could, however, affect adjacent or nearby landowners. The potential effect on nearby landowners is independent of mineral or surface ownership and depends primarily on proximity and on mitigation of noise and visual effects.

Some of the new CBM wells that would be developed in the area would be drilled in known locations, and some would be developed somewhere within general locations or open-drilling “windows.” These windows are 20 to 30 acres, some smaller and some larger, depending on the size and dimension of the specific section of land. Impacts on the value of a property would vary, based on the specific location of the CBM wells and associated facilities relative to nearby residences. Since the proposed locations for most of the new CBM wells are in drilling windows rather that at known sites, potential effects on residential property values would be estimated on a case-by-case basis when the well locations are known. In general, wells drilled farther away or obstructed from view would have less potential to affect residential properties than would those completed closer to residences.

Because of all of these factors, the potential impacts on individual property values that could result from CBM development would be highly variable and difficult to quantify. BBC Research & Consulting (BBC) prepared a report, "*Measuring the Impact of Coalbed Methane Wells on Property Values: A Working Paper*" (BBC 2001b), to assess potential impacts on residential property values from CBM development. This study indicated that some positive and some negative effects on property values have resulted from proximity to CBM wells that had already been developed in the area.

In the study, BBC attempted to compare sales of properties with CBM wells on or near them to sales of similar properties without CBM wells. BBC concluded that only a small number of the properties sold between 1989 and the first half of 2000 were affected by the proximity of a CBM well. Over this 11-year period, the number of properties sold with a CBM well at the time of sale was too small to analyze statistically. The BBC analysis concluded, however, that the value of these properties was affected negatively by the presence of a CBM well. In addition, properties sold in this period without wells, but near them on adjoining properties, showed effects on property value that were highly variable and both positive and negative.

As stated earlier, specific impacts on residential property values can be estimated only on a case-by-case basis, considering all the relevant variables that affect property values. Individual effects on property values must be considered when comparing properties with on-site or nearby wells with properties without them. BBC's study considered only some of the parameters that control the value of a residential property.

In Table 3–199, the parameters BBC used are compared with the factors used by the La Plata County Assessor's Office to establish a property value assessment. As shown in the table, not all the variables used by the assessor to set values for real estate were considered in the BBC model. In addition, other important factors that affect real estate value also were not considered in BBC's model. These factors include the "neighborhood" where a property is located, as well as topography, vegetation, water features, views, the quality of construction and finish, and the general condition.

Many of these factors cannot be modeled effectively to compare properties, because they are less tangible and more difficult to quantify. The same is true of the subjective opinion and preferences of the potential buyers for a property. The location-related factor included in the model was distance from Durango. Although distance provides good information regarding the properties that were included in the evaluation, it has no direct effect on value.

**Table 3–199 Property Value Assessment Factors**

| Factor | La Plata County Assessor[1] | BBC Model[1] |
|---|---|---|
| Parcel Number | X | |
| Date of Sale | X | X |
| Sale Price | X | X |
| Lot Size | X | X |
| Type of Use (vacant, residential, mobile home) | X | X |
| Distance from Durango (miles) | | X |
| Year of Construction (age of house) | X | X |
| Square Footage by Floor Level | X | X |
| Total Improved Square Footage | X | |
| Garage (type & square feet) | X | X |
| Number of Bathrooms | X | |
| Number of Bedrooms | X | |
| Type of Heat | X | |

Note:

[1] X indicates that the factor is used (blank indicates factor is not used) for property value assessment.

Sources: Allen and Associates 2001; BBC 2001b

Given the limitations of the BBC study, it cannot be considered an accurate predictive model for assessing potential effects on property value from development of CBM wells.

The La Plata County Assessor does not routinely adjust assessed property values based on proximity of a CBM well. The assessor would consider an adjustment to the assessed value for CBM well effects, however, if it could be shown that the market price of a property was affected (Kotlar 2000). La Plata County has identified the need for a case-by-case analysis of properties before wells are constructed, to identify damages and compensation for the surface owner (La Plata County 2002b).

In general, property values in La Plata County have appreciated by 6.9 percent per year over the past decade and are expected to continue to appreciate at this rate (BBC 2001b). Some property values could be reduced by effects of well proximity but would be expected to increase in value afterwards at the same relative rate, as would properties with no effects from wells.

From another perspective, additional CBM development would increase the total annual revenues to both La Plata and Archuleta Counties. County revenues from *ad valorem* property taxes on gas production would increase from the proposed additional CBM development for the life of the project. Therefore, if the values of some properties were reduced, this would be unlikely to reduce the total property tax revenues to the two counties in the Project Area. Overall, additional CBM development would increase the property tax revenues for both counties in the Project Area, despite modest decreases in property values in some cases.

Although they are not directly related to property value, property tax revenues generated by CBM development would offset the amount of taxes that would otherwise have to be collected from other sources. For example, individual landowners could pay reduced amounts of annual taxes because of the increased property taxes paid by the proposed CBM production.

### 3.16.3.11 Environmental Justice

Under Executive Order 12898, in 1994, proposed projects under the jurisdiction of federal agencies must address "environmental justice" in minority and low-income populations. The analysis of project effects must include the potential for disproportionately high, adverse human health and environmental impacts on low-income and minority populations.

The proposed project would have no additional or disproportionate effects on minority populations. As shown in Table 3–165, there are smaller percentages of minorities in both La Plata and Archuleta Counties, compared with Colorado as a whole. The statewide population in the year 2000 was 4 percent black, compared with 0.1 percent in Archuleta County and 0.2 percent in La Plata County. In the year 2000, the statewide population was 17.1 percent Hispanic. For the year 2000, the Hispanic population in La Plata County was 10.4 percent and in Archuleta County, 16.8 percent. In the Project Area, the minority populations include a higher number of Native Americans, compared with the remainder of the state. For example, in 2000, Native Americans made up 5.8 percent of La Plata County, compared with 1 percent statewide.

Nor would the proposed project have additional or disproportionate effects on low-income populations. As shown in Table 3–173, both the median household income and the per capita income in La Plata and Archuleta Counties are slightly lower than the statewide figures. In the year 2000, nearly 50 percent of the households in both counties earned an annual income of less than $20,000. As shown in Table 3–172, the 1999 annual incomes for 8.9 percent of Colorado residents place them below the poverty line. The percentages for both counties are somewhat higher. In La Plata County, 10.4 percent of the residents were considered living below the poverty line in 1999. For Archuleta County, 12.7 percent of the residents were considered living below the poverty line. However, regional differences in cost of living may account for some of the differences in income. There would be no disproportionate effects on neighborhoods with low-income populations, because the proposed locations of the project facilities are geographically dispersed throughout the Project Area.

## 3.16.4 Cumulative Effects

To analyze cumulative effects on social and economic values, we estimated the potential effects of CBM development in the NSJB by calculating the sum of the socioeconomic effects of the following past, present, and reasonably foreseeable actions.

- The existing oil and gas development in the Project Area, as previously discussed in the section on Affected Environment.
- The Preferred Alternative of the Final Environmental Impact Statement for Oil and Gas Development on the Southern Ute Indian Reservation (BLM et al. 2002).

- The alternatives considered for the proposed project.

With or without additional CBM development, the populations of both counties in the Project Area are expected to increase over the life of the proposed project. Therefore, additional socioeconomic effects are likely to occur because of this anticipated community expansion. The current trends in development indicate that population, employment, housing, local facilities, services and infrastructure, and net county revenues would increase over the life of the project, with or without additional CBM development in both La Plata and Archuleta Counties.

### 3.16.4.1 Population

Under Alternative 1, the cumulative change in population that would result from employment in the oil and gas sector would represent an increase of less than 3 percent, compared with the total in the region. Therefore, there would be a small increase in population, and little or no effect on the demographics of La Plata and Archuleta Counties or the NSJB region.

However, the populations in both La Plata and Archuleta Counties are expected to continue to increase, with or without additional CBM development. Between 1990 and 1999, the population of unincorporated La Plata County increased by about 54 percent. The population in Archuleta County increased by more than 25 percent between 1993 and 1998 (BBC 2002). The population in the region is also projected to increase over the life of the project.

The cumulative effects on population and demographics for Alternatives 1A, 1B, 3, 4, and 5 would be the same as Alternative 1's. Under Alternative 2, the cumulative employment would be larger, compared with the other alternatives. The cumulative employment would represent an increase in population of less than 4 percent, however, compared with the total population of both La Plata and Archuleta Counties. In addition, the majority of the project workers would come from the NSJB region. Therefore, the cumulative effects on the population and demographics for Alternative 2 would be similar to Alternative 1's.

### 3.16.4.2 Employment

Under Alternative 1, the cumulative employment in the oil and gas sector would represent an increase of less than 3 percent, compared with the total employment in the region. In addition, the regional economy is well diversified. The cumulative employment in the oil and gas sector would represent a small increase in total employment in La Plata or Archuleta Counties or the NSJB region.

The cumulative effects on total employment in the region for Alternatives 1A, 1B, 3, 4, and 5 would be the same as Alternative 1's. The cumulative employment in the oil and gas sector would be greater for Alternative 2, compared with the other alternatives. The cumulative employment for Alternative 2 would represent less than 4 percent of the total employment in the region. Therefore, there would be a small increase in the total employment in the two counties or the NSJB region and the cumulative effects would be similar to Alternative 1's.

### 3.16.4.3 Earnings and Income

Under Alternative 1, the cumulative number of jobs in the oil and gas sector would be small, compared with total employment and income in the region. Therefore, there would be a small increase in earnings or per capita income in La Plata or Archuleta Counties or the region. The cumulative effects for Alternatives 1A, 1B, 2, 3, 4, and 5 would be similar to Alternative 1's.

### 3.16.4.4 Housing

For any of the alternatives, the cumulative number of new residents who would require housing would be small. Therefore, there would be a small increase in demand on the local housing market and little or no effect on the availability of housing in La Plata or Archuleta Counties or the NSJB region.

### 3.16.4.5 County Facilities, Services, and Infrastructure

For any of the alternatives, the cumulative employment for CBM development would result in a small number of new residents, compared with the total population of the two counties. There would be a small increase in demand for county facilities, services, and infrastructure, because there would be few additional residents as a result of the project. However, the populations in both La Plata and Archuleta Counties are projected to increase, even without additional CBM development. Therefore, there may be impacts on county facilities, services, or infrastructure from population increases that are unrelated to CBM development.

### 3.16.4.6 Fiscal Conditions of Local Government

The cumulative revenues associated with Alternative 1 would generate substantial additional revenues for both La Plata and Archuleta Counties. *Ad valorem* property taxes would be the primary direct source of increased revenues for both La Plata and Archuleta Counties. Cumulatively, Alternative 1 would increase annual property tax revenues to La Plata County by $1.4 million, compared with current revenues. Cumulatively, Archuleta County annual property tax revenues would increase by $600,000, compared with current revenues.

The new CBM wells associated with Alternative 1 would generate little or no revenues for the SUIT. However, assuming a constant gas price ($2/mcf) over the life of the project, the cumulative CBM wells in the NSJB would generate an estimated total of $118 million (1997 dollars) in revenues to Colorado tribes over the life of the project (BLM et al. 2002). The cumulative royalties to the SUIT from CBM development on tribal land would generate an average of $5.9 million per year (1997 dollars and constant gas price) (BLM et al. 2002).

The cumulative effects on the fiscal condition of local government for Alternatives 1A and 1B would be the same as Alternative 1's. Cumulatively, Alternative 2 would increase annual property tax revenues to La Plata County by $2.9 million, compared with the current level. Annual property tax revenues to Archuleta County would increase by $800,000 compared with the current level. The cumulative revenues to the SUIT would be the same as Alternative 1.

Cumulatively, implementation of Alternative 3 would increase annual property tax revenues to La Plata County by $1.4 million, compared with current revenues. Annual property tax revenues in Archuleta County would increase by $300,000, compared with current revenues. The cumulative revenues to the SUIT would be the same as Alternative 1's.

Implementation of Alternative 4 would increase the cumulative annual property tax revenues to La Plata County by $1.4 million, compared with current revenues. Annual property tax revenues in Archuleta County would increase by $200,000, compared with current revenues. The cumulative revenues to the SUIT would be the same as Alternative 1's.

The cumulative effect, if additional federal wells are not allowed, would be a loss of additional revenues to both counties, compared with the various action alternatives. Cumulatively, annual property tax revenues to La Plata County would increase by $1.2 million, compared with current revenues. Annual property tax revenues in Archuleta County would increase by $70,000, compared with current revenues. The cumulative revenues to the SUIT would be the same as Alternative 1's.

### 3.16.4.7 Impacts from Eventual Decline in Gas Revenues and Boom-and-Bust Cycle

Under Alternative 1, the cumulative effects of oil and gas development would affect county revenues moderately at the end of the project. As of the year 2000, revenues for the existing oil and gas production in La Plata County were considered to be at an all-time high (La Plata County 2002a). As the production rates for the cumulative CBM wells in the La Plata County decrease, production-related revenues would decline over time, with or without additional CBM development. The net revenues for both counties are projected to increase over time, however, regardless of the decline in production-related revenues. Overall, county revenues from property taxes are expected to increase over time. It is likely that the reduced property tax revenues that would result from the end of the project would be somewhat offset by increased total assessed valuation in La Plata County, from additional residential and commercial development. Additional sources of revenue may be required, however.

The cumulative effects on county revenues and the potential for a boom-and-bust cycle for Alternatives 1A and 1B would be the same as Alternative 1's. The cumulative effects on county revenues and the potential for a boom-and-bust cycle for Alternatives 2, 3, 4, and 5 would likewise be similar to Alternative 1's.

### 3.16.4.8 County Expenditures

Under Alternative 1, the cumulative oil and gas development would have a moderate effect on county expenditures, but these costs would be greatly offset by the additional county revenues from gas production. County expenditures are likely to increase with or without additional CBM development. The populations in both La Plata and Archuleta Counties have increased at a high rate over recent years and are projected to continue to grow. Therefore, there may be impacts on county expenditures because of general increases in population that are unrelated to CBM development.

Under Alternatives 1A, 1B, 2, 3, 4, and 5, the cumulative effects on county expenditures would be the same as Alternative 1's.

## 3.16.5 Mitigation and Monitoring

The cumulative social and economic effects for any alternative would be positive, resulting in substantial economic benefits to both La Plata and Archuleta Counties. Therefore, we identified no mitigation measures for effects on social and economic values associated with the proposed CBM development.

## 3.16.6 Conformance to Existing Plans and Policies

Additional CBM development on federal leases would meet the goals for management of energy resources set forth in the LRMP for the SJNF (FS 1992a) and the RMP for the San Juan/San Miguel Planning Area (BLM 1985). CBM development on private or state leases would conform to both COGCC requirements and the existing local regulations and policies.

## 3.16.7 Unavoidable Adverse Effects

As production would eventually decline in the NSJB Region, gas-related revenues to local governments would also decline gradually. Production-related revenues would decline in a gradual manner over a 30-year period, and so would represent less than 1 percent of the total county revenues at the end of the project.

## 3.16.8 Irreversible and Irretrievable Effects

There would be substantial economic benefits from any alternative to both La Plata and Archuleta Counties for the life of the project. These benefits include increased local-government revenues and employment in the region. These effects are irretrievable but are not irreversible. These effects are not irreversible because production-related revenues and project employment would cease at the end of the project. However, the positive effects from CBM-related revenues and employment would be irretrievable because they would occur for the life of the project.

# 3.17 Health and Safety

## 3.17.1 Issues

*Issue 3: The effects of additional CBM development on human health and safety.*

- What are the risks to human health associated with underground coal fires?
- What is the potential for contamination of drinking-water aquifers by chemicals used in hydraulic fracturing and by ruptures of pipelines?
- Is hydrogen sulfide a health risk to the local community, and how will it be monitored?
- What is the potential for accidental spills from generation, handling, and storage of hazardous and nonhazardous chemicals and wastes?
- What is the potential for illegal dumping of hazardous materials?
- What is the potential for fire or explosion of CBM wells?

## 3.17.2 Affected Environment

The public has expressed concerns about the effects of additional CBM development and its potential risks to human health and safety.

The affected environment was described in other chapters (see "Demographics").

Briefly, from the standpoint of human health and safety, the affected environment consists of rural development, with residences built on densities from one to more than 40 acres. Private land is used for agriculture (crops and grazing), as well as horse pastures and some vacant, uncultivated land. National Forest and BLM land in the Project Area is used for recreation, grazing, and energy development. Two communities, Bayfield and Gem Village, are within the Project Area. A higher density of residences and businesses may be affected in these communities.

Most rural residences have shallow groundwater wells for their source of domestic water, and some have cisterns and delivered potable water.

CBM wells, pipelines, and other facilities are interspersed within the rural residential and agricultural areas. Based on setback requirements for many of the facilities, wells and pipelines cannot be installed close to residences or other public buildings.

### 3.17.2.1 Underground Coal Fires

Underground coal fires occur throughout the U.S. In populated areas, they can destroy property through subsidence of the ground surface and potentially can cause burns or exposure to high levels of carbon monoxide in the vented gases. If subsidence is sufficient, it could lead to collapse of structures. Subsidence is unlikely, because coal fires advance slowly, but should not be ruled out as a hazard.

Dewatering of near-surface coal seams and fluctuating groundwater levels in coal beds can trigger heating and supply oxygen that may cause spontaneous combustion (BLM 1999). To date, no active coal fires have been reported in the Project Area (Keller 2001, BLM et al. 2002). Active coal fires can be identified on the surface by open fissures issuing steam and pungent odors, slump areas, active areas of mass earth movement, and dying trees and other vegetation.

Active coal fires occur on the Southern Ute Indian Reservation along the northwestern rim of the San Juan Basin, just south of the study area. These fires may be interconnected in the subsurface, but were noted in several distinct areas.

In 2000, members of the Southern Ute Indian Tribe were concerned about the loss of the resource and about public-safety issues associated with the coal fires (BLM et al. 2002). They enlisted the services of a reputable firm that had been successful in extinguishing coal fires in other areas. After more than $1 million had been exhausted, it was apparent that the problem was larger than anticipated. Considering that an additional $5 million could be required and success was not guaranteed, the efforts were abandoned, since that sum would exceed the value of the coal to be saved. The fires have decreased in intensity in the areas addressed, but have also apparently shifted to other areas. Another, smaller fire apparently closer to the surface will be attacked with bulldozers, in an effort to extinguish it.

Geologic evidence, such as scoria or “Red Dog” (reddish tinted, heat-altered rocks), indicates that coal fires have occurred in prehistoric times. The scoria can be observed frequently along the outcrop of the Fruitland Formation. It commonly occurs in the Menefee Formation outcrops in La Plata County, as well (for example, in Wildcat Canyon and west of Durango on Highway 160).

### 3.17.2.2 Contamination of Drinking Water Aquifers by Hydraulic Fracturing or Pipeline Ruptures

Hydraulic fracturing (“fracing”) is a process used in development of CBM to fracture the coal bed, to facilitate release of methane. Water and other fluids are mixed with sand or glass beads (proppants). The fluids and proppants are pumped into the well at high pressures, causing existing fractures to open and creating new ones. The proppants hold the fractures open. Studies have shown that hydraulic-fracturing fluids and materials remain in the coal beds, typically within 600 feet of the well bore (Diamond 1995).

In addition, the fractures have been shown to propagate almost completely within the coal beds. There is little, if any, propagation of fractures into overlying or underlying rock bodies (sandstone and shale). When fracturing is completed, the fluids are pumped back to the surface for disposal. The proppants remain in the fractures. Typically, more than 90 percent of the fluids pumped into the well bore are recovered initially. The remaining fluids either remain in the formation or are recovered after production is initiated. (See Chapter 2 for a complete description of the hydraulic-fracturing procedures.)

The Fruitland Formation is not considered a principal aquifer in the Project Area (Robson and Banta 1995). The Fruitland Formation is separated from the principal aquifers in the SJB by confining layers (Lewis Shale below and Kirtland Shale above).

To date, none of the constituents used in hydraulic fracturing has been documented in shallow domestic water wells or groundwater supplies in the SJB. The EPA has reviewed hydraulic fracturing associated with oil and gas development and concluded that there is little, if any, chance for frac fluids to migrate into drinking water supplies (EPA 2002a). The EPA study was prompted by concerns from the Black Warrior Basin CBM in Alabama, where shallow coal beds were being fractured. These shallow coal beds are either within the drinking-water aquifer system or just below the water supply aquifers. Coal beds in the Fruitland Formation are separated from shallow aquifers by more than 1,000 feet of low-permeability shale and siltstone.

Residents who own domestic water wells in La Plata County have asserted that fracing a nearby CBM well has affected water wells. One landowner noted that his well, which had a depth to water of 7 feet below ground surface, began flowing water to the ground surface directly after the CBM well (700 feet distant) was artificially stimulated. His well has had continued artesian flow and is contaminated by hydrogen sulfide. Other water well owners in La Plata County have also indicated that water quality diminished after a local gas well was completed. In some cases, the impacts on water quality occur for only several days after the CBM well is completed. In other cases, however, landowners have claimed that CBM development induces a permanent change in water quality.

Several owners of domestic wells have reported that hydraulic fracturing or cavitation in nearby CBM wells has temporarily affected the water quality in domestic wells. These well owners have complained that wells produced cloudy water for 3 or 4 days after work at the CBM well. It is likely that vibrations from development of the CBM well agitated water in domestic wells and loosened some of the fine-grained material in the gravel pack for the domestic well or in the well sump.

Some water quality degradation in shallow wells may be linked to vibrations caused by CBM well completion. The vibrations from deeper formations can agitate fine-grained material in old, shallow wells, suspending them in the water and causing a temporary discoloration and "off" taste.

Pipelines associated with CBM development include gathering pipelines for transporting gas and produced water. Based on previous oil and gas development projects, most ruptures occur when heavy equipment accidentally strikes the pipeline. Recently, a resident of La Plata County was killed when he accidentally excavated a gas pipeline. The ruptured gas line burst into flame, burning the man severely.

Markers are posted at frequent intervals along the pipeline, to prevent inadvertent excavation of pipelines and reduce the risk of accidental ruptures. Regulations require that flows in the pipeline be monitored either by remote sensors or by daily inspections of the flow meters, to reduce the probability of undetected leaks or ruptures and to minimize their duration.

In a 1994, a pipeline fracture northwest of Bayfield led to high concentrations of methane in a domestic water supply nearby (BLM 1999). After the pipeline leak was repaired, the concentrations of methane in the water well decreased. Generally, pipeline leaks of any magnitude will be visible through loss of vegetation and are readily repaired. The losses of vegetation appear temporary.

### 3.17.2.3 Hydrogen Sulfide

There is concern about the potential health risk of hydrogen sulfide and how it is monitored during CBM development. Since the Project Area's natural gas formation is "sweet" (does not contain sulfur compounds), hydrogen sulfide is not typically encountered during drilling in the Project Area (BLM et al. 2002, La Plata County Energy Council 2002). Samples of gas from each CBM well are collected and analyzed every 6 to 12 months during the production phase. To date, no measurable amounts of hydrogen sulfide have been detected in CBM wells in the Project Area.

Hydrogen sulfide is a toxic gas with a "rotten eggs" odor and can be lethal in concentrations above 500 parts per million (ppm) in air. It can be detected by odor at lower concentrations than laboratory equipment can analyze, but olfactory nerves become desensitized to concentrations that exceed 100 ppm within a few minutes or by long-term exposure at only 50 ppm, and cannot be effective in safeguarding against exposure to hazardous levels of the gas.

Within the Project Area, hydrogen sulfide gas has been measured in shallow soil vapor tubes at Carbon Junction, Pine River, and Texas Creek along the outcrop of the Fruitland Formation. Historical reports of hydrogen sulfide odor have been recorded at Carbon Junction before CBM development began. Vapor tubes on the outcrop of the Fruitland Formation on the east side of the Animas River have shown sporadic occurrences of hydrogen sulfide, with no discernible trends. The hydrogen sulfide occurs in two domestic wells at Texas Creek, one abandoned and scheduled to be plugged, and lower levels have been found in a domestic well at the Walker residence (CR 502). More than 400 ppm of hydrogen sulfide has been detected in the abandoned domestic well. These concentrations are considered hazardous, and the COGCC has scheduled this well to be plugged in 2003.

Although some measurements of soil gas recorded to date show levels of hydrogen sulfide far in excess of permissible air standards, ambient air concentrations have not exceeded the normally accepted OSHA concentrations of 10 ppm in air.

There are two possible mechanisms for creation of hydrogen sulfide: inorganic oxidation of sulfide minerals (such as pyrite) by near-surface recharging groundwater, and organic metabolism of sulfates by sulfate-reducing bacteria. It appears that most occurrences of hydrogen sulfide in the Project Area are associated with coal beds, which also creates an association between hydrogen sulfide and elevated concentrations of methane in shallow groundwater.

Although hydrogen sulfide has not been detected in any of the CBM wells within the Project Area, intensified methane seepage and an apparent escalation of levels of hydrogen sulfide gas were reported at historical seep sites within the Southern Ute Reservation as development of CBM gas progressed. (BLM et al. 2000) Applicable regulations at the federal, state, and La Plata County levels govern development of oil and gas on leases where the presence of hydrogen sulfide is suspected or confirmed. These regulations are described below.

If hydrogen sulfide is encountered or suspected on federal leases, monitoring the concentration (as well as other potential actions such as signage, contingency planning, etc.) is required by federal regulations in Title 43 CFR Part 3160, Onshore Oil and Gas Operations Regulations, Onshore Order 6, Hydrogen Sulfide. Under the Occupational Safety and Health Act of 1970, treatment methods or corrective measures are required during work operations when the concentration of hydrogen sulfide in ambient air exceeds 10 ppm.

COGCC Rule 607 requires that, on private or state leases, the results of the analysis for gas be reported when they indicate the presence of hydrogen sulfide. Under this rule, a drilling-operations plan for hydrogen sulfide is required as part of the APD, Form 2. This plan must be developed if concentrations of hydrogen sulfide in excess of 100 ppm can reasonably be expected to be encountered during well drilling or servicing.

A project-specific emergency preparedness plan is required under the La Plata County Land Use System (La Plata County 1997) for CBM development on private land. This plan is required for projects that involve drilling or penetration through zones of hydrogen sulfide, as determined by the county's public-safety officer. The plan is to be submitted before field operations begin.

Based on discussions with the COGCC field inspectors, no related human-safety incidents have been reported related to releases of hydrogen sulfide that are associated with CBM development (Weems 2002). Hydrogen sulfide gas has been noted in one CBM well on the western side of the Southern Ute Indian Reservation, south of the Project Area. No hydrogen sulfide has been measured in CBM wells in the Project Area.

### 3.17.2.4 Risk of Accidental Spills and Illegal Dumping

There is concern that further CBM development will increase the potential for accidental spills and illegal dumping of chemicals and hazardous wastes. A search of the COGCC database (April 2002) revealed no reported spills or releases that exceeded 5 barrels (the reportable quantity) from CBM facilities in the Project Area (COGCC 2002). Minor spills of drilling fluids, the contents of pits, or CBM produced waters were documented but did not require formal reporting, because of the limited volumes.

Furthermore, no documented illegal dumping has been associated with CBM development in the Project Area (Weems 2002). Illegal dumping of hazardous materials carries severe penalties, and many materials can be traced easily. Criminal and civil penalties apply to illegal dumping, along with the associated cleanup costs and costs of emergency response. Operating companies and their contractors understand the financial and environmental risks of illegal dumping, which deters them from this activity.

These factors reduce, but do not completely eliminate, the likelihood of illegal dumping of hazardous materials. In the event that it occurs, an interagency emergency response team that is trained to contain and clean up the materials will respond. The team also investigates the illegal dumping to identify the party responsible and pursue legal action. Illegal dumping on federal land is investigated and remediated by BLM and FS personnel trained in response and criminal investigations.

Table 2–10, Hazardous Materials Used or Potentially Used by the Companies, lists the chemicals and hazardous materials associated with the project. Typical wastes generated during CBM development are discussed in Section 2.4.2.2, Waste Sources and Controls.

Transportation of hazardous materials is addressed in federal regulations (Title 49 CFR Parts 171–180). Under Title 40 CFR Parts 355, 370, and 372, facilities and operations that store significant amounts of chemicals must notify certain government agencies (including the EPA and state and local emergency response agencies; other agencies, such as the Coast Guard or U.S. Department of Transportation, must be notified in certain circumstances). The threshold quantity for most chemicals is 10,000 pounds. For facilities with an aboveground storage capacity of more than 1,320 gallons of oil or petroleum products, the federal regulations (Title 40 CFR Part 112) require a Spill Prevention Control and Countermeasure Plan (SPCC). The goal of the SPCC is to prevent spills from reaching waterways. Oil spills must be reported to the U.S. Coast Guard National Response Center, as required by Title 40 CFR Part 125.

Most wastes generated at oil and gas production facilities are exempt from the Resource Conservation and Recovery Act (RCRA) regulations for hazardous wastes from point of generation to point of disposal. Compressor stations are generally small-quantity generators for hazardous wastes, producing between 100 and 1,000 kilograms per month (220 to 2,200 pounds). Spills or releases of reportable quantities that occur beyond the boundary of the facility must be reported to the EPA and appropriate local agencies, under Section 101 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The operators are required to submit an Environmental and Safety Contingency Manual to the BLM for oil and gas leases on federal minerals. The procedures to contain, stop, or control the source of spills are addressed in the manual. The manual generally includes the location of spill control equipment, procedures for control of releases of hydrogen sulfide, and protocols for shutting down ignition sources in the event of a release of gas or pipeline rupture. It also must include telephone numbers for medical and emergency response personnel and agencies and procedures for handling and disposing of spilled chemicals, oils, hazardous substances, contaminated soils, or other contaminated materials.

These procedures are intended to minimize the potential for spills to contaminate surface water or groundwater. The procedures are also intended to reduce hazardous-materials exposure to workers and the public. The BLM also requires the construction of containment berms around aboveground tanks, to minimize the impacts of leaks and spills. Bermed areas must have 110 percent of the capacity of the tank. Moreover, the BLM requires berms around the well pad during drilling and completion, to contain releases of fluids.

Wells drilled on private and state leases must comply with the standard procedures required by COGCC rules. Section 906b(1) of COGCC rules requires reporting of spills or releases of exploration and production waste or produced fluid that exceed 5 barrels, including any contained in unlined berms. Prevention measures for spills and releases required under this rule include secondary containment for tanks that contain crude oil, condensate, or produced water with a TDS concentration above 10,000 mg/L. The COGCC rules limit the amount of materials stored near wellheads, tanks, and separators.

Under COGCC rules, a Site Investigation/Remediation Work Plan, Form 27, is required if potential adverse environmental impacts could result from a spill, or for spills that exceed 20 barrels of extraction and production waste. Any remediation required must occur in a manner to mitigate, remove, or reduce contamination in soils and groundwater, to meet the allowable concentrations and levels in COGCC Table 910–1 (COGCC 2002b).

### 3.17.2.5 Well Fires or Explosion

There is concern about the potential for fire or explosion of CBM wells. Based on discussions with the COGCC field inspector, however, no well fires or explosions related to CBM wells have occurred in the past 15 years. The only explosion associated with CBM development was in a building enclosing a metering unit and separator unit. Apparently, gas had leaked and accumulated in the building. When the field operator arrived for the weekly inspection, his cell phone set a spark and ignited a fire. The operator sustained substantial burns but recovered.

Well fires could result from a blowout during drilling or workover, or from a gas leak during operations. Drilling operations on federal mineral leases must comply with Onshore Oil and Gas Order No. 2, Drilling (Title 43 CFR Part 3160). This rule establishes standard safety procedures for drilling and minimum blowout-prevention equipment, to control abnormally high pressures if they are encountered during drilling operations.

The potential for pipeline leaks and ruptures is discussed in Section 3.17.3.2, Contamination of Drinking Water Aquifers by Hydraulic Fracturing or Pipeline Ruptures.

Well operations on federal leases are also regulated under Title 43 CFR Chapter II, Subpart 3162.5–Environmental Obligations. Approval of a drilling-and-operations plan is required as part of the well-permitting process. The plan must address the procedures to be employed for fire prevention and firefighting procedures, safety precautions, and emergency plans.

Wells drilled on private and state leases must comply with the standard safety procedures required by COGCC rules. COGCC rules include operating procedures for fire prevention and protection and a requirement that materials that are not in use but that may constitute a fire hazard be removed a minimum of 25 feet from the wellhead, tanks, and separator. Flammable liquids are not to be stored within 50 feet of the well bore, except for the fuel in the tanks of operating equipment or to supply injection pumps.

In addition, there are minimum setback distances between wells and occupied structures, as well as pipelines and structures. In the event of fire, these setbacks should be a sufficient buffer to prevent well fires from burning houses and injuring residents. Where pipelines are routed within densely populated areas, American Petroleum Institute (API) standards require overall higher standards to protect the public. These standards include emergency shutdown systems, stronger materials for the pipe wall, construction standards, welding inspection, and other factors that may affect pipeline performance in the event of a failure.

## 3.17.3 Environmental Consequences

Risks to human health and safety associated with CBM development would primarily apply to construction and production personnel, and, to a lesser extent, to the public. The Companies would take measures to protect public safety, including warning signs that would be posted around all facilities, guardrails at pumping units, and fencing at compressor stations, for any of the alternatives.

The potential impacts on human health and safety can be directly tied to the issues discussed above, as well as the risks to well site workers who are engaged in an inherently hazardous activity (working with high–pressure, combustible gas). Other potential impacts that were not discussed include unauthorized digging near pressurized-gas pipelines, vandalism to pipeline markers, and unauthorized persons tampering with valves and fittings at wellheads.

### 3.17.3.1 Underground Coal Fires

Although it is well documented that spontaneous combustion can ignite underground coal beds, no known cases of coal fires can be directly linked to CBM development in the San Juan Basin. The mechanism for creating coal fires may, however, be related to CBM development. The mechanism for coal fires is the heat of hydration that facilitates spontaneous combustion of underground coal, especially where the groundwater table fluctuates. Coals most susceptible to self-heating are of high intrinsic moisture content with available oxygen, as found in low-rank coals such as sub-bituminous or lignite. Fruitland coals are low rank.

If the coal bed is an aquifer (as it tends to be in this area) and the water table fluctuates, even slightly, the heat of wetting potential is increased dramatically by removal of water. When water levels drop in unconfined aquifers (as has been observed along the Fruitland coal outcrop), ambient air is drawn into the coal beds, thus supplying the necessary oxygen to support combustion or oxidation. Once the self-heating temperature (SHT) is reached, the coal tends to produce a sustained exothermic reaction that increases oxidation until smoldering and combustion occur. The SHT can be as low as 30 degrees Celsius in lignite and subbituminous coals.

Because it appears the CBM wells in the Fruitland Formation are hydraulically interconnected to some degree with the outcrop areas, a mechanism for igniting coal fires exists. Groundwater levels in water wells and springs at the outcrop have been documented to be decreasing since the 1990s. Whether known coal fires south of the Project Area have been recently ignited or only rekindled from dormant or latent smoldering fires is unknown. Whether the fires were kindled or exacerbated by the increased water withdrawal is likewise unknown. Forest fires have also been proposed as providing the spark necessary to ignite the coals.

The scoria and "Red Dog" altered rocks are evident in areas north of the boundary of the Southern Ute Indian Reservation. Therefore, it appears that coal fires have burned in times past in the Northern San Juan Basin. It is possible that these areas could be rekindled. Withdrawal of produced water could be a factor, because the gas wells are hydraulically interconnected to the coal beds in the outcrop.

#### 3.17.3.1.1 *Alternative 1—Proposed Action*

Because of the hydraulic interconnection between downdip gas wells and the outcrop and the geologic indicators of past coal fires in the Northern Basin, the risk for ignition or re-ignition of coal fires would be in the low to moderate range and long term. If fires were ignited, the commensurate gas vents, fissures, and collapse features could be anticipated. Public exposure to gas vents could lead to carbon monoxide poisoning, burns (vented gases are extremely hot), and possibly collapse of the overburden. As noted above (page 3–2), it is unlikely that a catastrophic and unpredicted collapse of inhabited structures would occur, because of the slow progress of coal fires.

Typically vents are localized, but their locations cannot be predicted. Therefore, any new coal fires would require close monitoring and possibly restricted access to the affected area. People who are unaware of the possible dangers associated with coal fires may be the first to encounter a new fire, when risks to human health are greatest. Given land ownership patterns on the outcrop of the Fruitland Formation within the Project Area, it is likely that private citizens could be the first to encounter any new coal fires.

#### 3.17.3.1.2 *Alternative 1A*

Under this alternative, fewer wells would be drilled than under Alternative 1. Therefore, the probability of underground coal fires would be minimally less than under Alternative 1.

#### 3.17.3.1.3 *Alternative 1B*

Under this alternative, fewer wells would be drilled than under Alternative 1. Therefore, the probability of underground coal fires would be minimally less than under Alternative 1A.

#### 3.17.3.1.4 *Alternative 2*

The risk of igniting a coal fire would increase commensurately with the increased proximity of CBM wells to the outcrop. An increased potential for decreasing the water table near the outcrop would exist. Risks would increase to moderate and long term. Hazards to public health are as described in Alternative 1.

#### 3.17.3.1.5 *Alternative 3*

This alternative would result in risks and impacts similar to Alternative 1.

#### 3.17.3.1.6 *Alternative 4*

This alternative would result in risks and impacts similar to Alternative 1.

#### 3.17.3.1.7 *Alternative 5—No Action*

Fewer CBM wells and associated facilities would be installed under this alternative, compared with the other alternatives; the potential risk to human health and safety from underground coal fires would be similar, however, to Alternative 1.

### 3.17.3.2 Contamination of Drinking-Water Aquifers by Hydraulic Fracturing or Pipeline Ruptures

Two issues are discussed in this section: the possible contamination of shallow aquifers from hydraulic fracturing, and contamination by leaking pipelines (either gas or produced-water pipelines.) Other hazards are posed by ruptured gas pipelines, such as fires, explosions, and severe burns.

#### 3.17.3.2.1 *Hydraulic Fracturing*

The fractures that propagate from the well bore terminate within approximately 600 feet. In addition, the petrophysical properties of coals interbedded with shale and sandstone serve to isolate most of the fractures within the coal beds (Diamond 1995). After fracturing, the fluids used to slurry the proppants (sand or glass balls) are pumped back out of the formation. Typically, about 90 percent of the fluids are recovered during this phase of well development (Erwin). [Hydraulic fracturing is discussed in detail in Chapter 2.]

Typically, the exploitable coal beds in the Fruitland Formation are found at depths greater than 1,200 feet below the ground surface. The intervening Kirtland Shale and shallower formations provide sufficient hydraulic separation between the fractured coal beds and the shallow aquifers to preclude migration of frac fluids into the shallow aquifers. In addition, a zone of low pressure is established in the Fruitland Formation around the well bore, once a well is completed and begins producing. Within this zone, flow of fluid is to the point of lowest pressure, the well bore. Therefore, there is little possibility during the production phase that the unrecovered frac fluids could migrate into shallower aquifers.

In 2002, the EPA completed an exhaustive study to evaluate whether hydraulic fracturing should be regulated through the Underground Injection Control (UIC) well program. The EPA's study was focused on cases where hydraulic fracturing in oil and gas wells contaminated domestic drinking-water wells. EPA could find no case where domestic well contamination could be linked to hydraulic fracturing in nearby oil and gas wells. The EPA cautioned investigators that the possibility of contamination should not be ignored, however, particularly where geologic conditions do not provide the degree of separation between the oil-and-gas-producing zones and the drinking-water aquifer. In the Project Area, the geologic conditions provide sufficient separation, with the exception of the areas near the outcrop. However, these areas are considered uneconomic for CBM development.

### 3.17.3.2.2 *Pipeline Ruptures*

The Bureau of Transportation Statistics (BTS) reports an average of one safety incident (including ruptures) per year per 5,455 miles of pipeline in the U.S. (BTS 2002). There are currently 196 miles of pipelines (gathering and trunk line) within the Project Area. A maximum of 203 additional miles of pipelines would be installed under the maximum-development scenario of Alternative 2, for a total of 399 miles of pipelines. Applying the BTS assumption of one safety incident per year for every 5,455 miles of pipeline, and assuming this incident rate is industry standard and the pipelines within the Project Area meet or exceed industry standards, we could expect one safety incident every 24 years. Because the expected lifetime of the project is 25 years, one safety incident could thus be expected over the lifetime of the project.

There has been one known case in La Plata County where a leaking methane pipeline has contaminated a nearby water well. When the pipeline leak was repaired, the concentration of methane in the affected well quickly diminished.

No cases of leaking produced-water pipelines affecting water wells have been documented to date.

The alternatives call for increasing density and linear footage of gas and water pipelines, and would increase the potential for pipeline ruptures that may affect water wells. The greater the number of pipelines, the greater the chance ruptures could occur.

The potential for pipeline ruptures increases as the pipelines age. Corrosion, both internal and external, can weaken the pipe wall, making it susceptible to rupture or leaks. Operators in the Project Area conduct a maintenance program that checks the integrity of pipelines on a regular schedule, per API standards. When corrosion or leaks are detected, they are repaired immediately.

### 3.17.3.2.3 *Alternative 1—Proposed Action*

Alternative 1 would increase the potential that drinking-water wells may be contaminated by pipeline leaks, because of increased pipeline numbers and aging of the existing pipelines.

Based on a large body of evidence (Diamond 1995, EPA 2002a) it is considered unlikely that water wells would be contaminated by hydraulic fracturing.

### 3.17.3.2.4 *Alternative 1A*

Under this alternative, fewer wells would be drilled than under Alternative 1. Hydraulic fracturing does not occur with horizontal wells. Therefore, the effects of hydraulic fracturing would be less than under Alternative 1. Because some of the horizontal wells would be collocated on vertical well pads, the length of pipelines required would be less on National Forest land than under Alternative 1. Therefore, the probability of a pipeline rupture would be slightly less.

#### 3.17.3.2.5 *Alternative 1B*

Under this alternative, fewer wells would be drilled than under Alternative 1. Therefore, because there would be fewer wells and because horizontal wells are not fractured, the effects from hydraulic fracturing would be minimally less than under Alternative 1A. Because some of the horizontal wells would be collocated on vertical well pads, the length of pipelines required would be less than under Alternative 1. Therefore, the risk of contamination of drinking-water aquifers by pipeline ruptures would be slightly less than Alternative 1A.

#### 3.17.3.2.6 *Alternative 2*

Alternative 2 would involve installation of a larger number of CBM wells and more miles of pipelines, compared with the other alternatives.

The risk of contamination of drinking-water aquifers by hydraulic fracturing or pipeline ruptures would be higher than Alternative 1 because of the additional pipelines. If CBM wells were drilled near the outcrop, where the Fruitland Formation is fairly shallow, then the potential for hydraulic fracturing to contaminate shallow aquifers would increase.

#### 3.17.3.2.7 *Alternative 3*

The potential risk of contaminating drinking-water aquifers through hydraulic fracturing or pipeline ruptures would be similar to Alternative 1. The level of development within rural residential areas would be the same as Alternative 1; therefore, risks of well contamination remain the same.

#### 3.17.3.2.8 *Alternative 4*

Under implementation of this alternative, the potential risk of contamination of drinking-water aquifers by hydraulic fracturing or pipeline ruptures would be similar to Alternative 1. As with Alternatives 1 and 3, the level of CBM development in rural residential areas would be similar; therefore, the potential for contamination is similar.

#### 3.17.3.2.9 *Alternative 5—No Action*

Under this alternative, there would be a smaller number of CBM wells and fewer miles of pipelines (for both gas and production water), compared with the other alternatives. Therefore, the potential for contaminating shallow aquifers is reduced, although the risks are already low.

### 3.17.3.3 Hydrogen Sulfide

Within the Project Area, hydrogen sulfide is common in areas internal to the San Juan Basin Rim, most notably in the Gem Village area, Dry Creek and along CR #225, and in the Piedra River drainage in the area around Stollsteimer Creek. Along the Fruitland Formation outcrop, hydrogen sulfide exists in several domestic water wells between Texas Creek and the Pine River Ranches Subdivision as well as in several soil vapor tubes, notably in the Carbon Junction area near Durango.

Just north of the Fruitland outcrop (and this Project Area) domestic water wells in the Mesa Verde Formation show considerable hydrogen sulfide concentrations. In the Northern San Juan Basin, but south of the Project Area notable hydrogen sulfide is recognized in the Bondad/Sunnyside area internal to the Southern Ute Indian Reservation and in one gas well in the northwestern edge of the Basin. Numerous soil vapor tubes in the Fruitland outcrop on Reservation lands to the south show concentrations in excess of 2,000 ppm in subsurface soil gas. Rarely does the ambient air even then approach the OSHA 10 ppm threshold.

Existing hydrogen sulfide emissions are limited to one shallow well on the northwestern flank of the San Juan Basin, one shallow domestic well on the outcrop, and several shallow soil vapor tubes on the northern basin outcrop. Hydrogen sulfide appears to occur in near-surface regimes in the Fruitland Formation coal beds, particularly in areas subject to larger quantities of recharging groundwater. Since the overwhelming majority of CBM wells do not contain hydrogen sulfide, the risk of exposure is extremely low.

Although the risks of exposure are extremely low at this time, the BLM and COGCC also maintain ongoing outcrop-monitoring programs. The monitoring occurs throughout the year, and changes in conditions at the outcrop are observed, recorded, and mapped. In the event that hazardous conditions are observed, the safety requirements under oil and gas order No. 6 will be implemented, including reporting to the private landowner, along with safety measures the landowner and general public must observe around the hazard areas.

In the event that conditions change within the reservoir of the Fruitland Formation or if hydrogen sulfide is encountered in wells drilled in undeveloped regions of the Project Area, the standard safety procedures must be followed for releases of hydrogen sulfide at drilling operations. Employee training is required for emergency response, including monitoring for hydrogen sulfide. If hydrogen sulfide is encountered or suspected, a contingency plan is required and treatment or corrective measures must be implemented, if the concentrations exceed the regulatory standard.

#### 3.17.3.3.1 *Alternative 1——Proposed Action*

Because existing monitoring data show the absence of hydrogen sulfide in deeper coal beds, there is low probability that hazardous levels will be encountered in implementing Alternative 1. However, it is possible that "nuisance" non-hazardous levels of hydrogen sulfide may occur along the outcrop areas in the eastern portion of the Project Area as the groundwater table is drawn down due to increased CBM production.

Additional data on ambient air quality show that concentrations of hydrogen sulfide in La Plata County have never been documented at concentrations over the OSHA permissible-exposure limit of 10 ppm. Even in areas such as Carbon Junction, where hydrogen sulfide odors are evident, EPA monitoring has shown levels (several orders of magnitude less than OSHA permissible exposure limit.

#### 3.17.3.3.2 *Alternatives 1A, 1B, 3, 4, and 5*

Similar to the potential impacts described for Alternative 1, the risks to human health and safety from hydrogen sulfide are extremely low.

#### 3.17.3.3.3 *Alternative 2*

Similar to the potential impacts described for Alternative 1, the risks to human health and safety from hydrogen sulfide are extremely low. However, since hydrogen sulfide occurs near the outcrop of the Fruitland and larger number of wells would be drilled nearer the outcrop under Alternative 2, compared to Alternative 1, the risks of exposure to hazardous levels of hydrogen sulfide would be marginally greater.

### 3.17.3.4 Accidental Spills and Illegal Dumping

Federal regulations require tracking of chemicals and hazardous materials. Threshold volumes (reportable quantities) are defined in the federal regulation (40 CFR 302). These regulations cover transportation, storage, use, and disposal of chemicals, hazardous materials, and wastes.

Based on the history of the Project Area, the operators comply with the federal regulations to prevent and control spills, and manage wastes. The chemicals, hazardous materials, and wastes typically associated with CBM development for any of the alternatives are listed on Table 2–10.

The Companies are required to develop plans for all potential emergencies, including chemical releases or spills. Employee training is required on the emergency plan. Under Section 101 (14) of CERCLA and 40 CFR 125, spills or releases of reportable quantities of hazardous substances that occur beyond the boundary of the facility must be reported to the EPA, the National Response Center, and appropriate local agencies.

Several operators have established more stringent reporting requirements than required by regulations. For example, one large operator requires field personnel to report releases of 1 gallon of produced water, even on the well pad, when regulations require reporting releases of produced water that exceed 10 barrels. This stringent tracking of small releases allows the Companies to identify the work processes that require improvement to reduce the risk of spills.

As described above, there have been few cases of illegal dumping by the operators on the Project Area.

#### 3.17.3.4.1 *Alternative 1—Proposed Action*

The risk of an accidental spill would be proportionate to the amount of chemicals and hazardous materials transported, stored, and used in the Project Area. The operator's continued adherence to regulations and its own environmental-health-and-safety plans will minimize the potential for spills and illegal dumping of hazardous materials.

#### 3.17.3.4.2 *Alternative 1A*

The amount of chemicals and hazardous materials transported, stored, and used would be slightly less than under Alternative 1 because fewer wells would be drilled and operated. Therefore, the probability of accidental spills and illegal dumping would be equivalent to Alternative 1.

#### 3.17.3.4.3 *Alternative 1B*

The amount of chemicals and hazardous materials transported, stored, and used would be less than Alternative 1 because fewer wells would be drilled and operated. Therefore, the probability of accidental spills and illegal dumping would be equivalent to Alternative 1.

#### 3.17.3.4.4 *Alternative 2*

A larger number of CBM facilities is associated with this alternative, compared with the others. Because this alternative would increase the amount of chemicals and hazardous materials used or generated during operations, the potential for spills and illegal dumping increases, when compared to Alternative 1 or other alternatives. The potential for human health-and-safety effects from accidental spills or illegal dumping of chemicals, hazardous materials, and wastes remains low, if operators continue to adhere to their plans and the existing regulations.

#### 3.17.3.4.5 *Alternative 3*

Under this alternative, the potential for effects on human health and safety from accidental spills or illegal dumping of chemicals, hazardous materials, or wastes would be slightly lower than under Alternative 1, because the total number of wells and facilities would be lower and the associated use of chemicals and generated wastes also would be lower.

#### 3.17.3.4.6 *Alternative 4*

The potential for effects on human health and safety from accidental spills or illegal dumping of chemicals, hazardous materials, or wastes would be similar to Alternative 1.

#### 3.17.3.4.7 *Alternative 5—No Action*

A smaller number of CBM facilities is associated with this alternative, compared with the other alternatives. Therefore, the risk of spills and illegal dumping would lower, compared to Alternative 1.

### 3.17.3.5 Well Fire or Explosion

Standard safety procedures for well drilling, pipeline markers, monitoring, and inspections are required by federal and state regulations, to minimize the probability of a well blowout, undetected gas leak, or well fire. Regulations require that well sites be kept free of vegetation and trash, to minimize the potential for fires. The Companies are required to develop an emergency plan with defined fire prevention and firefighting procedures and telephone numbers for emergency services and contacts. This emergency plan must be posted at field facilities. Emergency response plans require employee and contractor training to respond to well fires and explosions.

In addition, BLM and COGCC inspectors witness testing of key safety equipment annually. For example, blowout preventers (BOPs) are tested for their pressure-rated performance, and these tests are witnessed by qualified inspectors to ensure the integrity of the equipment.

The BLM and COGCC review the operator's drilling plans and geologic conditions before they approve an APD. These reviews consider the reservoir pressures that may be encountered, compare these pressures to the operator's proposed equipment ratings, casing design, and cement program. Final approval is granted after the appropriate engineering checks are completed and the appropriate safety factors are confirmed.

The witnessing in the field and the pre-field engineering and geologic reviews are performed to avoid blowouts and well fires. These checks do not guarantee the integrity of the equipment, nor can they consider every potential geologic hazard that may be encountered. Therefore, well explosions and blowouts are considered a possible risk. Again, the operator's emergency plans consider these situations; the personnel are trained to respond, and the county emergency response crews are also trained to respond to these emergencies.

The Association of Mechanical Engineers (ASME) and API issue standards for the design, construction, installation, and maintenance of pressure vessels, fittings, piping, and pipelines. Operators and their contractors build, operate, and maintain all equipment and pipelines according to these standards, which are intended to minimize the potential for explosions and failure of the equipment. For example, API publishes standards on corrosion coatings for buried pipelines. These standards specify coating materials, material thickness, test procedures to ensure coatings are applied properly, test procedures to ensure no holes are in the coating, acceptance criteria, and handling and installation procedures, once the pipeline is coated and leaves the mill. Similar standards apply to all material and equipment used by the operators.

The risk of well fires and pipeline explosions posed by wildfires is very low. Buried pipeline present a low risk for explosion in the event a wildfire overruns the pipeline. Numerous wildfires have burned over buried pipelines in the Western U.S., and there are no reports of pipeline explosions resulting from these events. Wellheads and equipment are buffered by the bare ground of the well pad, which reduces exposure of this equipment to heat. In addition, operators have emergency shutdown plans in place in the event a wildfire threatens to overrun operating wells. Emergency shutdown can be implemented within minutes, in most cases.

As with all construction, all potential for human error cannot be eliminated. Thus, emergency response plans and training programs are required.

#### 3.17.3.5.1 *Alternative 1—Proposed Action*

Assuming that the operators, the BLM, and the COGCC implement the required safety procedures, and that reviews and inspections are performed, the 296 proposed CBM wells and associated facilities would pose a low risk for well fires or explosions.

#### 3.17.3.5.2 *Alternative 1A*

Because 12 fewer wells would be drilled under Alternative 1A than under Alternative 1, the 283 proposed CBM wells would pose a low potential for well fires or explosions.

#### 3.17.3.5.3 *Alternative 1B*

Because 64 fewer wells would be drilled under Alternative 1A than under Alternative 1, the 231 proposed CBM wells would pose a low potential for well fires or explosions.

#### 3.17.3.5.4 *Alternative 2*

Because this alternative proposes more wells and pipelines, the potential for an explosion or well fire is higher than with Alternative 1. Although the potential remains low, the risk of equipment failure increases with the larger number of pipes, fittings, separators, and other equipment.

#### 3.17.3.5.5 *Alternative 3*

Because fewer wells would be drilled, the risk for well fires or explosions would be lower for this alternative, compared with Alternatives 1 and 2.

#### 3.17.3.5.6 *Alternative 4*

Because fewer wells would be drilled, the risk for well fires or explosions would be lower for this alternative, compared with Alternatives 1 and 2.

#### 3.17.3.5.7 *Alternative 5—No Action*

Because fewer wells would be drilled, the risk for well fires or explosions would be lower for this alternative, compared with Alternatives 1 and 2.

## 3.17.4 Cumulative Effects

The analysis of cumulative human health and safety effects considers the existing and proposed development in the project plus the existing and level of development approved in the Southern Ute Indian Tribe FEIS (BLM et al. 2002). The SUIT FEIS analyzed development of 636 conventional and CBM gas wells and associated facilities on Tribal minerals and 519 CBM wells on non-tribal minerals within the bounds of the Southern Ute Reservation.

### 3.17.4.1 Underground Coal Fires

Under Alternative 1, the risk of underground coal fires from the cumulative 1,451 new gas wells (296 in the Project Area and 1,155 in the SUIT Project Area) would be moderate and long-term; however, coal fires are unlikely to pose a risk to human health and safety.

The effects on human health and safety as a result of underground coal fires associated with the cumulative CBM development under Alternatives 1A, 1B, 2, 3, and 4 are similar to Alternative 1. For Alternative 5, a smaller cumulative number of CBM wells and associated facilities would be installed in the Project Area, compared with the other alternatives; the effects on human health and safety associated with underground coal fires would be similar, however, to Alternative 1.

#### 3.17.4.2 Contamination of Drinking-Water Aquifers by Hydraulic Fracturing or Pipeline Ruptures

For Alternative 1, the cumulative effects of 1,451 new gas wells would pose a low potential risk of contamination of drinking-water aquifers by hydraulic fracturing. The cumulative miles of pipelines (both for natural gas and production water) associated with gas development would not be likely to affect drinking-water aquifers in the event of a probable pipeline incident that could occur one time in 12 years.

The cumulative number of new CBM wells and miles of pipeline associated with Alternatives 1A and 1B would pose a slightly lower risk of contamination of drinking-water aquifers by hydraulic fracturing or pipeline ruptures, compared with Alternative 1.

Under Alternative 2, the cumulative effects of the 1,677 new gas wells (522 in the Project Area and 1,155 in the SUIT Project Area) would pose a slightly higher, but still low, potential risk of contamination of drinking-water aquifers by hydraulic fracturing. The cumulative miles of pipelines (both for natural gas and production water) associated with gas development would not be likely to affect drinking-water aquifers in the event of a pipeline incident that could occur one time in 10 to 12 years.

The cumulative effects of Alternatives 3 and 4 would be similar to Alternative 1. Under Alternative 5, there would be fewer new gas wells and miles of pipelines, therefore, there would be a lower potential for contamination of drinking-water aquifers by hydraulic fracturing or pipeline ruptures compared with the other alternatives.

#### 3.17.4.3 Hydrogen Sulfide

Given the extremely low risk of hydrogen sulfide to human safety from individual wells, potential cumulative impacts are anticipated to be extremely low.

#### 3.17.4.4 Accidental Spills and Illegal Dumping

Under Alternative 1, the cumulative total of 1,451 new CBM wells and associated facilities would pose a minor risk of accidental spills. Assuming that the operators would implement the required emergency response plans and procedures, it is unlikely that human health and safety would be affected by spills or illegal dumping of chemicals, hazardous materials, or wastes from the cumulative CBM development associated with this alternative.

Under Alternatives 1A and 1B, the cumulative probability of accidental spills and illegal dumping would be equivalent to Alternative 1.

The cumulative effects of Alternative 2 would be a slightly higher risk of accidental spills and illegal dumping, because of the extra 226 CBM wells in the Project Area. The potential for effects on human health and safety would be low and similar to Alternative 1. Under Alternatives 3 and 4, the cumulative potential for effects on human health and safety from accidental spills or illegal dumping of chemicals, hazardous materials, or wastes would be low and similar to Alternative 1.

Under Alternative 5, there would be fewer new CBM wells and associated facilities. Therefore, the potential for human health-and-safety effects from accidental spills or illegal dumping of chemicals, hazardous materials, or wastes would be lower cumulatively compared with Alternative 1.

## 3.17.5 Mitigation and Monitoring

### 3.17.5.1 Coal Fires

Because much of the outcrop of the Fruitland Formation is on public and undeveloped private land, the danger from coal fires to the public is reduced. Physically hazardous areas of fissures and potential collapse could be cordoned off. Few homes exist on the Fruitland coal beds at the outcrop. Possible mitigation in the event of coal fires could include measures to extinguish the fires, but this has been shown to be impracticable in nearby areas. Early detection through monitoring efforts could result in mobilization of heavy equipment to excavate and extinguish new coal fires before they become unmanageable. Such activities will be funded by the Companies.

### 3.17.5.2 Hydrogen Sulfide

Since current COGCC Rule 607, the La Plata County Land Use Code, Oil and Gas Order No. 6, and OSHA regulations adequately address potential hydrogen sulfide risks to human health and safety, no further mitigation measures are necessary.

### 3.17.5.3 Stage 2 Fire Orders

When fire conditions are extreme, the BLM, FS, La Plata County, and Archuleta County issue fire orders to the operators, to reduce the potential for wildfires caused by oil and development.

### 3.17.5.4 Recommended Industry Procedures

The following documents produced by the API and ASME describe procedures that would enhance a safe and effective CBM operation in the Northern San Juan Basin:

**API Documents**

API Exploration Oil Field Equipment and Materials

API Exploration Series 4: Derricks and Masts

API Exploration Series 5: Tubular Goods

API Exploration Series 6: Valves and Wellhead Equipment

API Exploration Series 7: Drilling Equipment

API Exploration Series 8: Hoisting Tools

API Exploration Series 9: Wire Rope

API Exploration Series 10: Oil Well Cements

API Exploration Series 11: Production Equipment

API Exploration Series 12: Lease Production Vessels

API Exploration Series 13: Drilling Fluid Materials

API Exploration Series 15: Fiberglass and Plastic Pipe

API Exploration Series 16: Drilling Well Control Systems

API Exploration Series 19: Completion Equipment

API Exploration Drilling and Production Operations: Recommended Operating Practices

API Exploration Health, Safety, and Environment (Naturally Occurring Radioactive Materials)

API Exploration Health, Safety, and Environment (Safety and Fire Protection)

API Exploration Health, Safety, and Environment (Waste)

API Pipeline Transportation Pipeline Operations

API Safety and Fire Protection

API Storage Tanks

API Health and Environmental Issues—Pollution Prevention

API Industry Training—Exploration and Production

**ASME Documents**

An Engineer's Guide to Pipe Joints

Integrity of Structures and Fluid Systems, Piping and Pipe Supports, and Pumps and Valves

Components Analysis and Evaluation Aging and Maintenance and Pipe Supports

Pressure Surges Safe Design and Operation of Industrial Pipe Systems

Integrity of Structures and Fluid Systems, Hazardous Protection, Piping and Pipe Supports, Pump, Valves

Metallic Gaskets for Pipe Flanges

Ground and Cut Threads

Gas Transmission and Distribution Piping

Nonmetallic Flat Gaskets for Pipes Flanges

Managing System Integrity of Gas Pipelines

Process Piping

Boiler and Pressure Vessel Code

Pipeline Protection

Graphical Symbols for Diagrams; Basic mechanical Components

Determining remaining Strength of Corroded Pipelines: Supplement to Code-Pressure Piping

Scheme for the Identification of Piping Systems

## 3.17.6 Conformance to Existing Plans and Policies

CBM development in the NSJB would conform to the applicable federal, COGCC, and local health and safety laws and regulations. The regulations and rules applicable to CBM development are summarized in Section 2.4.

## 3.17.7 Unavoidable Adverse Effects

During the life of the project, there would be some additional human health and safety risks associated with construction and operation of CBM facilities in the Project Area. These risks would primarily be short term during the construction phase of the CBM development. However, there would be long-term risks associated with the presence of natural gas in the Project Area. CBM-related health and safety risks would primarily apply to the Companies' personnel, and to a lesser degree, the public.

## 3.17.8 Irreversible and Irretrievable Effects

During the life of the project, there would be some additional human health and safety risks associated with CBM development in the Project Area. CBM-related health and safety risks would primarily apply to the Companies' personnel, and to a lesser degree, the public. These effects would be irreversible but not irretrievable. Following successful reclamation, the materials, equipment, and facilities that could pose a CBM-related health and safety risk would be removed from the Project Area.

# 3.18 Air Quality and Climate

## 3.18.1 Issues

Public concerns raised during the scoping process for the EIS included: 1) The effects of additional CBM development on human health and safety and 2) The effects of additional CBM development on air quality and visibility.

Fugitive dust and exhaust from construction activities, along with air pollutants emitted during operation (separation and dehydration heaters, pipeline compression engines, and small well-head engines), are potential causes of air quality impacts. These sources of air pollution are more likely to become public issues where natural gas development activities occur near residential areas. The USDI-National Park Service (NPS) and the FS have also expressed concerns regarding potential atmospheric deposition (acid rain) and visibility impacts within mandatory federal Prevention of Significant Deterioration (PSD) Class I areas under their administration (Mesa Verde National Park and the Weminuche Wilderness Area).

## 3.18.2 Affected Environment

The air quality of any region is controlled primarily by the magnitude and distribution of pollutant emissions and the regional climate. The transport of pollutants from specific source areas is strongly affected by local topography. In the mountainous western United States, topography is particularly important in channeling pollutants along valleys, creating upslope and downslope circulation that entrain airborne pollutants, and blocking the flow of pollutants toward certain areas. In general, local effects are superimposed on the general synoptic weather regime and are most important when the large-scale wind flow is weak.

### 3.18.2.1 Topography

The Project Area is located in the northern portion of the SJB in southwestern Colorado (Figure 1–1). The topography of the Project Area varies from moderately steep to steep mountains, canyons, and mesas in the north-central and south-central portions, to rolling hills and gently sloping river valleys in the eastern and western regions. Elevations range from about 6,000 to nearly 9,000 feet. The Air Quality Impact Analysis Area (Figure 3–87) is larger, encompassing nearly 12,600 square miles of both northwestern New Mexico and southwestern Colorado.

### 3.18.2.2 Climate and Meteorology

The Project Area is primarily pinion-juniper woodland at elevations from 6,000 to 7,200 feet with average annual precipitation between 13 to 17 inches, and pinion-juniper/mountain browse at elevations from 6,100 to nearly 9,000 feet with average annual precipitation 14 to 20 inches.

Temperature and precipitation data obtained from the Western Regional Climate Center (WRCC) for Ignacio, Colorado, are considered to be representative of climatic conditions within the Project Area (WRCC 2003). However, because elevation, slope, and aspect affect precipitation and temperatures, the complex terrain results in considerable climatic variability. For the period of 1971 through 2000, annual precipitation measurements at Ignacio averaged 14 inches. Precipitation is typically well distributed throughout the year at nearly one inch per month, with June receiving the lowest average amounts (nearly 0.5 inch) and August the highest levels (1.7 inches). December and January were the coldest months, with average lows of about 10 °F and highs of about 40 °F. The warmest months were July and August with average minimum and maximum temperatures of 50 °F and 85 °F, respectively.

Representative wind measurements are limited within the Analysis Area. Meteorological data collected during 2002, and adequate to represent local air pollutant dispersion and transport adjacent to wells and compressor stations (near-field), were obtained from BP America's Natural Gas Processing Plant located near Bayfield, Colorado. Meteorological data adequate to represent regional air pollutant dispersion and transport throughout the Analysis Area was obtained from the 1990 MM4 (Pennsylvania State University/National Center for Atmospheric Research Mesoscale Model Version 4) and the California Meteorological Model (CALMET) data set, as previously used in the SUIT Oil and Gas EIS BLM 2000d).

### 3.18.2.3 Existing Air Quality

Although specific air quality monitoring is not conducted throughout most of the Analysis Area, air quality conditions are likely to be very good, as characterized by few air pollution emission sources (limited industrial facilities and few residential emissions, primarily from smaller communities and isolated ranches), good atmospheric dispersion conditions, as well as limited air pollutant transport into the Analysis Area, resulting in relatively low local air pollutant concentrations.

Known contributors to pollutant levels within the Project Area include the following:

- exhaust emissions (primarily carbon monoxide [CO] and oxides of nitrogen [$NO_x$]) from existing natural gas fired compressor and small wellhead engines, plus gasoline and diesel vehicle tailpipe air pollutants (CO, $NO_x$, particulate matter less than 2.5 microns in effective diameter [$PM_{2.5}$], particulate matter less than 10 microns in effective diameter [$PM_{10}$], sulfur dioxide [$SO_2$], and volatile organic compounds [VOC]).

- dust (particulate matter) generated by vehicle travel on unpaved roads, windblown dust from disturbed lands, and road sanding during the winter months.

- limited transport of air pollutants from emission sources located outside the Project Area.

The most complete air quality monitoring data available within the Analysis Area are from the SUIT operated station near Ignacio, Colorado, which has provided continuous measurements since 1987, and are considered to be the best available representation of background air pollutant concentrations throughout the Analysis Area (RTP Environmental 2004). These data were used to define background conditions (Table 3–200), and include impacts from existing sources both inside and outside the Analysis Area. The maximum pollutant concentrations recorded at Ignacio are well below applicable Colorado and National Ambient Air Quality Standards (NAAQS) for most pollutants, although maximum concentrations of ozone approaching the federal standard have been observed. Given the episodic nature of observed high ozone levels, their cause is uncertain, although regional transport or subsidence of stratospheric ozone is possible. These data are also consistent with estimated baseline concentrations provided by the Colorado Department of Public Health and Environment-Air Pollution Control Division (CDPHE-APCD) for rural southern Colorado, including estimated baseline levels for CO (1-hour and 8-hour), ozone (8-hour), and $PM_{2.5}$ (24-hour and annual).

Although the available Ignacio monitoring data adequately represent regional background conditions, they do not represent conditions immediately adjacent to large existing natural gas-fired emission sources (for example, compressors and small well-head engines) within the Analysis Area. Therefore, the near-field air quality impact dispersion modeling analysis explicitly included these existing sources, in addition to other reasonably foreseeable future development emission sources.

**Table 3–200 Assumed Background Concentrations of Regulated Air Pollutants**

| Pollutant | Averaging Time | Maximum Concentration ($\mu g/m^3$) | Second Max Concentration ($\mu g/m^3$) | NAAQS[1] ($\mu g/m^3$) |
|---|---|---|---|---|
| Carbon Monoxide | 1-hour | 2,300 | 2,300 | 40,000 |
| | 8-hour | 2,300 | 2,300 | 10,000 |
| Nitrogen Dioxide | Annual | 9 | N/A[2] | 100 |
| Ozone | 1-hour | 164 | 163 | 235 |
| | 8-hour | 137[3] | N/A | 157 |
| $PM_{2.5}$ | 24-hour | 26 | 20 | 65 |
| | Annual | 6 | N/A | 15 |
| $PM_{10}$ | 24-hour | 50 | 25 | 150 |
| | Annual | 15 | N/A | 50 |
| Sulfur Dioxide | 3-hour | 57 | 55 | 700[4] |
| | 24-hour | 23 | 23 | 365 |
| | Annual | 2 | N/A | 80 |

Notes:

1. Annual standards are not to be exceeded; short-term standards are not to be exceeded more than once per year.
2. N/A = not applicable.
3 The applicable "maximum" 8-hour ozone concentration represents the 3-year average of the fourth highest measured annual concentrations, as specified in the NAAQS regulations.
4 The applicable CDPHE-APCD standard of 700 $\mu g/m^3$ is more stringent than the NAAQS of 1,300 $\mu g/m^3$.

Source: RTP Environmental 2004

### 3.18.2.4 Regulatory Framework

The EPA establishes and revises the NAAQS as necessary to protect public health and welfare, setting the absolute upper limits for specific air pollutant concentrations at all locations where the public has access. Although EPA recently revised both the ozone and $PM_{2.5}$ NAAQS, these revised limits will not be implemented by the CDPHE-APCD until the Colorado State Implementation Plan is formally approved by EPA; until then, EPA is responsible for implementing these revised standards. This analysis of potential CBM development impacts must demonstrate compliance with all applicable local, state, tribal, and federal air quality standards.

Air pollution impacts would be limited by local, state, tribal and federal regulations, standards, and implementation plans established under the CAA and administered by the CDPHE-APCD (with EPA oversight). Air quality regulations require proposed new, or modified existing, air pollutant emission sources (including natural gas development facilities) undergo a permitting review before their construction can begin. Therefore, the CDPHE-APCD has the primary authority and responsibility to review permit applications and to require emission permits, fees and control devices, prior to construction and/or operation.

In addition, the U.S. Congress (through the CAA Section 116) authorized local, state and tribal air quality regulatory agencies to establish air pollution control requirements more (but not less) stringent than federal requirements (such as Colorado's 3-hour $SO_2$ ambient air quality standard). Additional site-specific air quality analysis would be performed, and additional emission control measures (including a BACT analysis and determination) may be required by the applicable air quality regulatory agencies to ensure protection of air quality resources. In addition, under the federal CAA and FLPMA, federal agencies can not authorize any activity which does not conform to all applicable local, state, tribal and federal air quality laws, statues, regulations, standards, and implementation plans.

The existing air quality of the Project Area is in attainment with all ambient air quality standards, as demonstrated by the relatively low concentration levels presented in Table 3–200. Given the Project Area's current attainment status, future development projects (under any Alternative) which have the potential to emit more than 250 tons per year of any criteria pollutant (or certain listed sources that have the potential to emit more than 100 tons per year) would be required to submit a pre-construction PSD Permit Application, including a regulatory PSD Increment Consumption Analysis under the federal New Source Review and permitting regulations. Development projects subject to the PSD regulations must also demonstrate the use of Best Available Control Technology (BACT) and show that the combined impacts of all applicable sources will not exceed the PSD increments for nitrogen dioxide ($NO_2$), $PM_{10}$, or $SO_2$. Finally, the permit applicant must demonstrate that cumulative impacts from all existing and proposed sources would comply with the applicable ambient air quality standards throughout the operational lifetime of the permit applicant's project.

In addition, a regulatory PSD Increment Consumption Analysis may be conducted at any time by the CDPHE-APCD or EPA, in order to demonstrate that the applicable PSD increment has not been exceeded by all applicable major or minor increment consuming emission sources. The determination of PSD increment consumption is a legal responsibility of the applicable air quality regulatory agency (with EPA oversight).

For example, the CDPHE-APCD (1999) conducted a detailed review of $NO_2$ PSD increment consumption in southwest Colorado, indicating that Class I increment values "are probably not violated" at the Mesa Verde National Park or the Weminuche Wilderness Area, but that preliminary results "suggest that there is one isolated hot spot in La Plata County where there is an apparent Class II PSD increment violation." The CDPHE-APCD worked closely with the emission source operator to better understand the specific situation, and has resolved this source-specific PSD Class II increment situation.

Mandatory federal Class I areas were designated by the U.S. Congress on August 7, 1977, including those existing wilderness areas greater than 5,000 acres in size and national parks greater than 6,000 acres in size. All other locations in the country were ambient air quality is within the NAAQS (including attainment and unclassified areas) were designated as PSD Class II areas with less stringent requirements. In addition, sources subject to the PSD permit review procedures are required to demonstrate that impacts to Air Quality Related Values (AQRV) will be below Federal Land Managers' Air Quality Related Values Workgroup (FLAG) "Limits of Acceptable Change" (FLAG 2000). The AQRVs to be evaluated include degradation of visibility, deposition of acidic compounds in mountain lakes, and effects on sensitive flora and fauna within the PSD Class I areas. For example, the FS San Juan National Forest Supervisor and Rocky Mountain Regional Forester are the Federal Land Managers directly responsible for the lands within the Weminuche Wilderness Class I area. Under the Clean Air Act, they are charged with "… an affirmative responsibility to protect the air quality related values (including visibility) of any such lands within a class I area…"

Therefore, most of the Analysis Area is currently designated as PSD Class II, while Mesa Verde National Park and the Weminuche Wilderness Area are protected by more stringent $NO_2$, $PM_{10}$, and $SO_2$ PSD Class I increment thresholds, as shown in Table 3–201.

**Table 3–201 Applicable PSD Increment Values**

| Pollutant | Averaging Time | PSD Class I Increments ($\mu g/m^3$) | PSD Class II Increments ($\mu g/m^3$) |
|---|---|---|---|
| Nitrogen Dioxide | Annual | 2.5 | 25 |
| $PM_{10}$ | 24-hour | 8 | 30 |
| | Annual | 4 | 17 |
| Sulfur Dioxide | 3-hour | 25 | 512 |
| | 24-hour | 5 | 91 |
| | Annual | 2 | 20 |

Source: RTP Environmental 2004

In addition, the CDPHE-APCD also requires various different pre-construction and operation permits, including: 1) any emission source with the potential to emit air pollutants in excess of 2 tons per year must submit an Air Pollution Emission Notice to CDPHE-APCD; 2) all emission sources with the potential to emit $NO_x$ or CO in excess of 10 tons per year, or 5 tons per year of $PM_{10}$, are required to obtain a permit before construction can begin; 3) sources with potential emissions in excess of 100 tons per year of CO, 40 tons per year of $NO_x$, or 15 tons per year of $PM_{10}$, must also include a new source modeling analysis in their permit application. CDPHE-APCD (2002) modeling guidelines specify the requirements for conducting modeling, including cumulative analyses; 4) all sources with the potential to emit any "criteria" air pollutant in excess of 50 tons per year must also provide the opportunity for the public to comment on the permit application; and 5) a Title V (or part 70) operating permit is required for all sources with the potential to emit air pollutants in excess of 100 tons per year. Since these pre-construction and operating permit programs are part of the Colorado State Implementation Plan, they have been approved (and are therefore enforceable) by EPA.

This NEPA analysis compares potential air quality impacts from the proposed action and alternatives to applicable ambient air quality standards, PSD increments, and AQRV impact threshold levels, but it does not represent a regulatory air quality permit analysis. Comparisons to the PSD Class I and II increments are intended to evaluate a "threshold of concern" for potentially significant adverse impacts, but do not represent a regulatory PSD Increment Consumption Analysis.

## 3.18.3 Environmental Consequences

No significant, adverse impacts to climate are anticipated from implementation of the proposed action or alternatives. Potential impacts to air quality were analyzed as described below.

### 3.18.3.1 Impact Types and Criteria

Potential air quality impacts from CBM development (proposed action and alternatives) were analyzed and reported solely under the requirements of NEPA, in order to assess and disclose reasonably foreseeable impacts to both the public and federal decision makers before a formal ROD is issued. Due to the preliminary nature of this NEPA analysis, it should be considered a "reasonable, but conservative" upper estimate of predicted impacts. Actual impacts at the time of development (subject to air pollutant emission source permitting by CDPHE-APCD) are likely to be less. An extensive Air Quality Impact Assessment Technical Support Document (RTP Environmental 2004) was prepared detailing the analysis procedures, and is available for review.

The air quality impact assessment was based on the best available engineering data and assumptions, meteorology data, and EPA dispersion modeling procedures, as well as professional engineering and scientific judgment. However, where specific data or procedures were not available, "reasonable, but conservative" assumptions were incorporated. For example, the air quality impact assessment assumed that all proposed Project Area CBM wells would go into production without any decline in production (no dry holes), then operate at full production levels (no "shut ins") throughout the 20 year life of project (LOP). Therefore, this NEPA analysis assumes a development scenario which is not likely to actually occur.

The air pollutant dispersion modeling was based on one-year of on-site meteorological data collected near Bayfield, Colorado, as well as regional data generated by the MM4 and CALMET models, including hourly regional surface observations and twice-daily upper air soundings throughout calendar year 1990 (BLM 2000d).

The EPA Industrial Source Complex – Short Term (ISCST; version 95250) atmospheric dispersion model was used to predict maximum potential near-field ambient air pollutant concentrations (in the vicinity of assumed compressor and small well-head engine emission sources) for comparison with applicable air quality standards and PSD Class II increments, as well as potential hazardous air pollutant (HAP) impacts. In addition, the EPA California Puff (CALPUFF; version 5.0) atmospheric dispersion model was used to determine maximum far-field ambient air pollutant concentrations, atmospheric deposition (acid rain) and visibility impacts at Mesa Verde National Park and the Weminuche Wilderness Area.

The criteria for determining the significance of potential air quality impacts include state, tribal and federally enforced legal requirements to ensure air pollutant concentrations will remain within specific allowable levels. These requirements include the Colorado ambient air quality standards and the NAAQS which set maximum limits for several air pollutant concentrations, and PSD increments which limit the incremental increase of specific air pollutants (including $NO_2$, $PM_{10}$, and $SO_2$) above legally defined baseline concentration levels. These legal limits are presented in Table 3–200 and Table 3–201 above. Where legal limits have not been established, the best available scientific information is used to identify thresholds of potential significant adverse impacts. Thresholds have been identified for HAP incremental cancer risk, potential atmospheric deposition impacts to sensitive lake water chemistry and terrestrial ecosystems, and a "just noticeable change" in potential visibility impacts.

When reviewing the predicted near- and far-field (proposed action and alternative) impacts, it is important to understand the "reasonable, but conservative" assumptions made regarding potential resource development. In developing this analysis, there is uncertainty regarding ultimate development (i.e., number of wells, equipment to be used, specific locations, etc.) The analysis was also based on a reasonably foreseeable development scenario, some of which are conservative assumptions:

- Maximum measured background criteria air pollutant concentrations were assumed to occur at all locations in the region throughout the LOP. In addition, the maximum predicted air quality impacts would occur only in the vicinity of the anticipated emission sources. Actual impacts would be less beyond the predicted points of maximum impact.

- All proposed action and alternative emission sources were assumed to operate at their reasonably foreseeable maximum potential emission rates simultaneously throughout the LOP. Given the number of sources included in this analysis, the co-probability of such a scenario actually occurring over an entire year (or even 24-hours) is small. While this assumption is typically used in modeling analyses, the resulting predicted impacts will be overstated.

- Maximum predicted operational air quality impacts are based on maximum projected development which would occur towards the end of the LOP. Since actual development would be phased in gradually, actual operational air quality impacts would also begin low, increasing throughout the LOP.

- All proposed Project Area CBM wells were assumed to be fully operational (no dry holes), at their maximum production rates, and remain operating (no "shut ins") throughout the LOP. This includes between 6,390 and 25,250 HP cumulative total gas-fired small well-head engines. In reality, well development equipment would be added or removed incrementally, as actual development requirements change.

- Maximum direct $NO_2$ impacts during operations were predicted based on assumed emissions from natural gas-fired separator and dehydrator heaters, central compressors operating at a reasonably foreseeable $NO_x$ emissions rate of 1.5 grams per horsepower-hour (g/HP-hour), as well as small well-head engines operating at an assumed $NO_x$ emissions rate of nearly 10 g/HP-hour. These assumptions reflect emission levels for recently permitted equipment. Higher emission rates (representing engines using historic proven technology) would cause greater impacts. Engines with lower emission rates (using emerging state-of-the-art technology) would cause lower impacts, but given the limited history of their actual use, it would be difficult to guarantee their performance throughout the LOP. The ultimate operational emission rate will depend on the specific control measures required by the applicable air quality regulatory agency (including the CDPHE-APCD and EPA). The ultimate authority for Clean Air Act emission control enforcement rests with these agencies.

- All proposed central compression engines (between 14,240 and 46,000 HP cumulative total) were assumed to operate at their maximum rated capacities continuously throughout the LOP (no phased increases or reductions). In reality, compression equipment would be added or removed incrementally as required by well field operations, compression engines would operate below full horsepower ratings, and it is unlikely all compressor stations would operate at maximum levels simultaneously.

- Total predicted short-term air pollutant impact concentrations were assumed to be the sum of the highest measured background concentration, plus the maximum cumulative modeled concentrations, which actually occur under very different meteorological conditions and are not likely to coincide.

- Preliminary $PM_{10}$ and $SO_2$ modeling analyses were performed for potential construction impacts in order to identify and apply the physical geometry for estimating the final maximum potential impacts. However, actual orientation of future construction activities is not known.

Given those "reasonable, but conservative" analysis assumptions described above, which may actually compound one another, the predicted impacts represent an upper estimate of potential air quality impacts which are unlikely to actually be reached. It is important to note that before actual development could occur, the applicable air quality regulatory agencies (including CDPHE-APCD and EPA) and the public would review specific air pollutant emissions preconstruction permit applications which examine potential project-wide air quality impacts. As part of these permits (depending on source size), the air quality regulatory agencies could require additional air quality impacts analyses or mitigation measures. Thus, before development occurs, additional site-specific air quality analyses based on actual facility engineering data would be performed to ensure protection of air quality.

### 3.18.3.2 Impacts Common to All Alternatives

Air quality impacts would occur during construction (due to surface disturbance by earth-moving equipment, vehicle traffic fugitive dust, well testing, and drilling rig and vehicle engine exhaust) and production (including natural gas separation and dehydration heaters, compressor and small well-head engine exhausts). The maximum predicted "near-field" air pollutant concentrations occur close to and between well locations; so close to each other that adding additional wells in other field locations would not increase the maximum predicted "near-field" concentration.

Air pollutant dispersion modeling was performed to quantify potential "reasonable, but conservative" $PM_{10}$ and $SO_2$ impacts during construction based on the individual pollutant's period of maximum potential emissions, assuming four well pads could be constructed concurrently within a single square mile. Construction emissions would occur during resource road and well pad construction (3 days), well drilling (8 days), and well completion testing (25 days). During well completion testing, natural gas would be burned (flared) for up to 7 days. Since the burned natural gas is "sweet" (does not contain sulfur compounds), no objectionable odors are likely to occur. In addition, since orientation of the road and well pad is unknown, several preliminary $PM_{10}$ and $SO_2$ modeling analyses were performed to identify and apply the physical geometry representing the maximum potential impacts in the final analysis (BLM 2000d).

Maximum potential near-field particulate matter emissions from traffic on unpaved roads and during well pad construction were used to predict the maximum 24-hour and annual average $PM_{10}$ concentrations. Maximum air pollutant emissions from each well would be temporary (i.e., occurring during a 36-day construction period). The amount of air pollutant emissions during construction would be controlled by watering or applying chemical surfactants to disturbed soils, and by air pollutant emission limits imposed by applicable air quality regulatory agencies. The control efficiency of dust suppressants was computed at 50 percent during construction (equivalent to 1 to 2 percent surface material moisture content per EPA guidance). Actual air quality impacts depend on the amount, duration, location and emission characteristics of potential emissions sources, as well as meteorological conditions (wind speed and direction, precipitation, relative humidity, etc.)

The maximum potential 24-hour $PM_{10}$ concentrations at least 650 feet (200 meters) from road and one-half mile (805 meters) from well emission sources (including a representative background value of 50 $\mu g/m^3$) would be nearly 127 $\mu g/m^3$, well below the applicable NAAQS of 150 $\mu g/m^3$. In addition, predicted particulate matter concentrations would decrease rapidly away from the emission source. Since these $PM_{10}$ construction emissions are temporary, PSD increments are not applicable.

The maximum short-term $SO_2$ emissions would be generated by drilling rigs and other diesel engines used during rig-up, drilling, and completion operations (sulfur is a trace element in diesel fuel). These $SO_2$ emissions would be temporary, occurring only during the limited 36-day construction period at each well location. The maximum modeled concentrations, including representative background values of 57 $\mu g/m^3$ (3-hour) and 23 $\mu g/m^3$ (24-hour), would be nearly 702 $\mu g/m^3$ (3-hour) and 132 $\mu g/m^3$ (24-hour). Therefore, predicted short-term $SO_2$ concentrations are slightly above the restrictive Colorado $SO_2$ Ambient Air Quality Standard of 700 $\mu g/m^3$ (3-hour) but well below 365 $\mu g/m^3$ (24-hour). The 3-hour $SO_2$ NAAQS (1,300 $\mu g/m^3$) is less stringent. Given the conservative assumptions used in this modeling analysis, significant impacts are unlikely to occur, even when compared to the more restrictive Colorado 3-hour standard. Since these $SO_2$ construction emissions are temporary, PSD increments are not applicable.

Maximum HAP (formaldehyde) impacts were predicted for all potential natural gas-fired compressor and small well-head engines. Since neither the CDPHE-APCD nor EPA have established formaldehyde standards, the maximum predicted formaldehyde concentrations were used to estimate potential incremental cancer risks compared to an acceptable range of 1 to 100 occurrences within one million cases. The maximum formaldehyde concentration was predicted to occur at 320 meters (less then 1/4 mile) adjacent to the largest compressor station; as the distance from the emission source increases, the predicted concentrations and incremental risk decrease rapidly. Since the capacity of this largest compressor station would not change significantly among Alternatives, the predicted increased cancer risk is consistent for all Alternatives. In addition, EPA (2004) recently proposed Maximum Achievable Control Technology (MACT) regulations for reciprocating internal combustion engines, which could be required on the assumed gas-fired compression engines, further reducing the predicted formaldehyde concentrations and associated risks.

Long-term (70-year) exposures from suspected carcinogenic emissions (for example, formaldehyde) were used to estimate the incremental cancer risk at the maximum predicted concentration location. These were calculated from EPA (2003) unit risk factors for carcinogenic constituents. Two estimates of cancer risk were made; one that corresponds to a most likely exposure (MLE) condition, and one reflective of the maximally exposed individual (MEI). The estimated incremental cancer risks were adjusted to account for duration of exposure (20-

year LOP) and time spent at home. Under the MLE scenario, the estimated incremental cancer risk associated with long-term exposure to formaldehyde (near the largest compression engine) would be 4.7 x $10^{-6}$. Under the MEI analysis, the maximum individual cancer risk for formaldehyde would be 14.7 x $10^{-6}$. Therefore, the predicted incremental cancer risks for the inhalation pathway all fall at the lower end of the 1 to 100 x $10^{-6}$ threshold range. Given the conservative nature of these analyses, the predicted exposures are likely to overstate actual exposures, and the potential incremental cancer risks would not be significant.

### 3.18.3.3 Alternative 1 — Proposed Action

Significant air quality impacts would not occur under Alternative 1. No violations of applicable state, tribal, or federal air quality regulations or standards are expected to occur as a result of direct or indirect CBM development-related air pollutant emissions (including construction and operation).

Air pollutant dispersion modeling was performed to quantify potential "reasonable, but conservative" CO and $NO_2$ impacts during operation, based on the period of maximum potential emissions. Operation emissions would occur due to natural gas-fired separator and dehydrator heaters, pipeline compressor and small well-head engines. It is anticipated additional field-wide compression would be approximately 41,000 HP (at 14 compressor stations), plus nearly 14,350 HP from 141 small well-head engines. Since produced natural gas is nearly pure methane and ethane, with little or no liquid hydrocarbons, no significant direct $SO_2$ or reactive VOC emissions would occur.

The maximum direct CO impacts during operation were predicted to be nearly 991 µg/m$^3$ (1-hour) and 389 µg/m$^3$ (8-hour). These values are below the EPA modeling guideline significance levels of 2,000 µg/m$^3$ (1-hour) and 500 µg/m$^3$ (8-hour). When these values are added to the assumed background concentration of nearly 2,300 µg/m$^3$, they would be less than 3,300 µg/m$^3$ (1-hour) and 2,700 µg/m$^3$ (8-hour), demonstrating compliance with the applicable NAAQS of 40,000 µg/m$^3$ (1-hour) and 10,000 µg/m$^3$ (8-hour), respectively.

The maximum potential near-field $NO_2$ concentrations were determined by multiplying maximum predicted $NO_x$ concentrations by 0.75, in accordance with standard EPA methodology (40 CFR 51, Appendix W, Section 6.2.3). The maximum predicted direct annual $NO_2$ impact was 24.8 µg/m$^3$, which is nearly equal to the applicable annual PSD Class II increment of 25 µg/m$^3$. When this value is added to the assumed representative background concentration (9 µg/m$^3$), the resulting predicted maximum total impact of 39 µg/m$^3$ is also well below the applicable NAAQS of 100 µg/m$^3$.

As stated previously, all NEPA analysis comparisons to the PSD Class II increments are intended to evaluate a threshold of concern, and do not represent a regulatory PSD Increment Consumption Analysis.

Potential direct atmospheric deposition (acid rain) and visibility impacts to the Mesa Verde National Park and Weminuche Wilderness PSD Class I areas were also calculated. The maximum direct total (wet and dry) nitrogen deposition within these areas during operation were predicted to be nearly 0.009 kilograms per hectare-year (kg/ha-year) and 0.007 kg/ha-yr, respectively; well below the 3 kg/ha-year threshold (Fox et. al. 1989). In addition, potential changes in Acid Neutralizing Capacity (ANC) at four lakes within the Weminuche Wilderness Area were all predicted to less than 0.8 percent (calculated for Upper Grizzly Lake), well below the 10 percent threshold for sensitive lakes (FS 2000).

Potential direct visibility impacts were calculated based on observed relative humidity, as well as speciated aerosol concentrations measured between 1988 and 2002 at both Mesa Verde National Park and the Weminuche Wilderness Area. If the air quality impacts predicted under Alternative 1 had occurred during the observed visibility measurement period, a 1.0 deciview "just noticeable change" would not have been exceeded at Mesa Verde National Park on any day, and would have been exceeded between 0 and 3 days per year at the Weminuche Wilderness Area. However, given the "reasonable, but conservative" assumptions incorporated into this analysis, these direct impacts are not likely to occur.

### 3.18.3.4 Alternative 1A

Significant air quality impacts would not occur under Alternative 1A. Given the lower number of potential well pad locations, overall air quality impacts would be somewhat less than those described in Section 3.18.3.3 Alternative 1 — Proposed Action above, although the maximum predicted air quality impacts associated with CBM operations would be very similar.

### 3.18.3.5 Alternative 1B

Significant air quality impacts would not occur under Alternative 1B. Given the lower number of potential well pad locations, overall air quality impacts would be somewhat less than those described in Section 3.18.3.3 Alternative 1 — Proposed Action above, although the maximum predicted air quality impacts associated with CBM operations would be very similar.

### 3.18.3.6 Alternative 2

Significant air quality impacts would not occur under Alternative 2. No violations of applicable state, tribal, or federal air quality regulations or standards are expected to occur as a result of direct or indirect CBM development-related air pollutant emissions (including construction and operation).

Air pollutant dispersion modeling was performed to quantify potential "reasonable, but conservative" CO and $NO_2$ impacts during operation, based on the period of maximum potential emissions. Operation emissions would occur due to natural gas-fired separator and dehydrator heaters, pipeline compressors, and small well-head engines. It is anticipated additional field-wide compression would be approximately 46,000 HP (at 17 compressor stations), plus nearly 25,250 HP from 274 small well-head engines. Since produced natural gas is nearly pure methane and ethane, with little or no liquid hydrocarbons, no significant direct $SO_2$ or reactive VOC emissions would occur.

The maximum direct CO impacts during operation were predicted to be nearly 1,218 $\mu g/m^3$ (1-hour) and 431 $\mu g/m^3$ (8-hour). These values are below the EPA modeling guideline significance levels of 2,000 $\mu g/m^3$ (1-hour) and 500 $\mu g/m^3$

(8-hour). When these values are added to the assumed background concentration of nearly 2,300 µg/m$^3$, they would be less than 3,600 µg/m$^3$ (1-hour) and 2,800 µg/m$^3$ (8-hour), demonstrating compliance with the applicable NAAQS of 40,000 µg/m$^3$ (1-hour) and 10,000 µg/m$^3$ (8-hour), respectively.

The maximum potential near-field $NO_2$ concentrations were determined by multiplying maximum predicted $NO_x$ concentrations by 0.75, in accordance with standard EPA methodology (40 CFR 51, Appendix W, Section 6.2.3). The maximum predicted direct annual $NO_2$ impact was 24.8 µg/m$^3$, which is nearly equal to the applicable annual PSD Class II increment of 25 µg/m$^3$. When this value is added to the assumed representative background concentration (9 µg/m$^3$), the resulting predicted maximum total impact of 38 µg/m$^3$ is also well below the applicable NAAQS of 100 µg/m$^3$.

As stated previously, all NEPA analysis comparisons to the PSD Class II increments are intended to evaluate a threshold of concern, and do not represent a regulatory PSD Increment Consumption Analysis.

Potential direct atmospheric deposition (acid rain) and visibility impacts to the Mesa Verde National Park and Weminuche Wilderness PSD Class I areas were also calculated. The maximum direct total (wet and dry) nitrogen deposition within these areas during operation were predicted to be nearly 0.013 kg/ha-year and 0.054 kg/ha-yr, respectively; well below the 3 kg/ha-year threshold (Fox et. al. 1989). In addition, potential changes in ANC at four lakes within the Weminuche Wilderness Area were all predicted to less than 1.2 percent (calculated for Upper Grizzly Lake), well below the 10 percent threshold for sensitive lakes (FS 2000).

Potential direct visibility impacts were calculated based on observed relative humidity, as well as speciated aerosol concentrations measured between 1988 and 2002 at both Mesa Verde National Park and the Weminuche Wilderness Area. If the air quality impacts predicted under Alternative 2 had occurred during the observed visibility measurement period, a 1.0 deciview "just noticeable change" would not have been exceeded at Mesa Verde National Park on any day, and would have been exceeded between 0 and 3 days per year at the Weminuche Wilderness Area. However, given the "reasonable, but conservative" assumptions incorporated into this analysis, these direct impacts are not likely to occur.

### 3.18.3.7 Alternative 3

Significant air quality impacts would not occur under Alternative 3. Given the lower number of potential well pad and compressor station locations, overall air quality impacts would be less than those described in Section 3.18.3.3 Alternative 1 — Proposed Action above.

### 3.18.3.8 Alternative 4

Significant air quality impacts would not occur under Alternative 4 - Continuation of Current Management Direction. Given the lower number of potential well pad and compressor station locations, overall air quality impacts would be less than those described in Section 3.18.3.3 Alternative 1 —Proposed Action above.

### 3.18.3.9 Alternative 5 — No Action

Significant air quality impacts would not occur under Alternative 5 — No Action. No violations of applicable state, tribal, or federal air quality regulations or standards are expected to occur as a result of direct or indirect CBM development-related air pollutant emissions (including construction and operation).

Air pollutant dispersion modeling was performed to quantify potential "reasonable, but conservative" CO and $NO_2$ impacts during operation, based on the period of maximum potential emissions. Operation emissions would occur due to natural gas-fired separator and dehydrator heaters, pipeline compressor and small well-head engines. It is anticipated additional field-wide compression would be approximately 14,240 HP (at 6 compressor stations), plus nearly 6,390 HP from 59 small well-head engines. Since produced natural gas is nearly pure methane and ethane, with little or no liquid hydrocarbons, no significant direct $SO_2$ or reactive VOC emissions would occur.

The maximum direct CO impacts during operation were predicted to be nearly 646 $\mu g/m^3$ (1-hour) and 382 $\mu g/m^3$ (8-hour). These values are below the EPA modeling guideline significance levels of 2,000 $\mu g/m^3$ (1-hour) and 500 $\mu g/m^3$ (8-hour). When these values are added to the assumed background concentration of nearly 2,300 $\mu g/m^3$, they would be less than 3,000 $\mu g/m^3$ (1-hour) and 2,700 $\mu g/m^3$ (8-hour), demonstrating compliance with the applicable NAAQS of 40,000 $\mu g/m^3$ (1-hour) and 10,000 $\mu g/m^3$ (8-hour), respectively.

The maximum potential near-field $NO_2$ concentrations were determined by multiplying maximum predicted $NO_x$ concentrations by 0.75, in accordance with standard EPA methodology (40 CFR 51, Appendix W, Section 6.2.3). The maximum predicted direct annual $NO_2$ impact was 23.6 $\mu g/m^3$, which is nearly 94 percent of the applicable annual PSD Class II increment of 25 $\mu g/m^3$. When this value is added to the assumed representative background concentration (9 $\mu g/m^3$), the resulting predicted maximum total impact of nearly 37 $\mu g/m^3$ is also well below the applicable NAAQS of 100 $\mu g/m^3$.

As stated previously, all NEPA analysis comparisons to the PSD Class II increments are intended to evaluate a threshold of concern, and do not represent a regulatory PSD Increment Consumption Analysis.

Potential direct atmospheric deposition (acid rain) and visibility impacts to the Mesa Verde National Park and Weminuche Wilderness PSD Class I areas were also calculated. The maximum direct total (wet and dry) nitrogen deposition within these areas during operation were predicted to be nearly 0.002 kg/ha-yr and 0.006 kg/ha-year, respectively; well below the 3 kg/ha-year threshold (Fox et. al. 1989). In addition, potential changes in ANC at four lakes within the Weminuche Wilderness Area were all predicted to less than 0.3 percent (calculated for Upper Grizzly Lake), well below the 10 percent threshold for sensitive lakes (FS 2000).

Potential direct visibility impacts were calculated based on observed relative humidity, as well as speciated aerosol concentrations measured between 1988 and 2002 at both Mesa Verde National Park and the Weminuche Wilderness Area. If the air quality impacts predicted under Alternative 5 — No Action had occurred during the observed visibility measurement period, a 1.0 deciview "just noticeable change" would not have been exceeded at either Mesa Verde National Park or the Weminuche Wilderness Area on any day.

### 3.18.3.10 Cumulative Effects

Air pollutant dispersion modeling was performed to quantify potential CO and $NO_2$ impacts during operation, based on the period of maximum potential emissions and other emission sources located within the Analysis Area (including tribal, Colorado, and New Mexico reasonably foreseeable sources.) Operation emissions would occur due to natural gas-fired separator and dehydrator heaters, small well-head engines, and increased pipeline compression requirements. Since produced natural gas is nearly pure methane and ethane, with little or no liquid hydrocarbons, no significant direct $SO_2$ or reactive VOC emissions would occur.

In addition, since the maximum direct modeled CO impacts (nearly 1,218 $\mu g/m^3$ (1-hour) and 431 $\mu g/m^3$ (8-hour) for Alternative 2 - Maximum Development) were below the EPA modeling guideline significance levels of 2,000 $\mu g/m^3$ (1-hour) and 500 $\mu g/m^3$ (8-hour), cumulative CO impacts were assumed not to be significant. Based on this analysis, it is assumed the cumulative effect of CO impacts from the proposed action and alternatives (plus other existing and reasonable foreseeable sources, and representative background concentrations) will would not exceed applicable air quality standards.

Potential maximum annual cumulative $NO_2$ concentrations, under Alternatives 1, 2, and 5, were predicted to be 93.0 $\mu g/m^3$, 93.2 $\mu g/m^3$, and 92.8 $\mu g/m^3$, respectively; close to, but not exceeding the annual $NO_2$ NAAQS of 100 $\mu g/m^3$. Since the reasonably foreseeable $NO_x$ emissions are dominated by existing and reasonably foreseeable sources (the proposed action and alternative sources account for nearly one percent of the total impact), the predicted maximum cumulative $NO_2$ concentrations are nearly the same among all Alternatives.

Potential maximum cumulative $NO_2$ concentrations, atmospheric deposition (acid rain) and visibility impacts to the Mesa Verde National Park and Weminuche Wilderness PSD Class I areas are presented in Table 3–202. The USDI-National Park Service and the USDA-Forest Service consider potential visibility impacts within their mandatory federal PSD Class I areas greater than a 1.0 deciview "just noticeable change" from cumulative air pollutant emission sources to be an adverse impact. Given the "reasonable, but conservative" assumptions incorporated into the visibility impact analysis, the cumulative impacts are likely to be less than those presented in Table 3–202, although the NPS and FS visibility "Limit of Acceptable Change" of more than a single day above a 'just noticeable change' (FLAG 2000) could be exceeded between 0 to 4 days per year at Mesa Verde National Park, and between 0 to 12 days per year at the Weminuche Wilderness PSD mandatory federal Class I areas.

### Table 3–202 Maximum Potential Cumulative Air Quality Impacts by Management Alternative (including reasonably foreseeable Colorado, New Mexico and SUIT emission sources without Farmington RMP sources)

| | | | Alternative | | | |
|---|---|---|---|---|---|---|
| PSD Class I Area | Pollutant | Units | 1 | 2 | 5 | Impact Threshold |
| Mesa Verde | Nitrogen Dioxide | Annual (μg/m$^3$) | 0.25 | 0.26 | 0.24 | 2.5 |
| | Atmospheric Deposition | Total Nitrogen Deposition (kg/ha-yr) | 0.10 | 0.10 | 0.09 | 3 |
| | Visibility | Greater than 1.0 deciview (days/year) | 0 to 3 | 0 to 4 | 0 to 3 | More than 1 day/year |
| Weminuche | Nitrogen Dioxide | Annual (μg/m$^3$) | 0.18 | 0.24 | 0.12 | 2.5 |
| | Atmospheric Deposition | Total Nitrogen Deposition (kg/ha-yr) | 0.07 | 0.11 | 0.07 | 3 |
| | Upper Grizzly Lake Chemistry[1] | ANC Change (percent) | 3.4 | 3.9 | 2.9 | 10 |
| | | ANC Change (μeq/l) | 0.8 | 0.9 | 0.7 | 1.0 |
| | Visibility | Greater than 1.0 deciview (days/year) | 0 to 3 | 0 to 12 | 0 to 6 | More than 1 day/year |

Note:
1. Potential cumulative impacts at other sensitive lakes would be less.
Source: RTP Environmental 2004

In addition to the cumulative air pollutant emission sources described above (including the proposed action and alternative sources, as well as other reasonably foreseeable emission sources located in Colorado, New Mexico, and on SUIT lands), the BLM recently initiated the process by which future natural gas development could occur under the jurisdiction of the Farmington, New Mexico, Field Office (BLM 2003a). Although the ROD (BLM 2003b) does not approve development of any additional individual wells (future NEPA analyses will be required prior to approving specific development), a "reasonable, but conservative" assessment of the possible air quality impacts from potential additional development in New Mexico was performed under this Draft NSJB CBM EIS.

The Farmington Proposed RMP included nearly 5,000 natural gas-fired well-head engines (operating at a 9.6 gm/HP-hour $NO_x$ emission rate) and 360,000 HP of additional natural gas-fired pipeline compression (operating at a 1.5 gm/HP-hour $NO_x$ emission rate). These potential emission sources were analyzed based on the following modeling assumptions:

- maximum projected development which could occur at the end of the LOP.
- wells would be fully operational (no dry holes), operate continually at maximum production rates, and remain operating (no "shut ins") throughout the LOP.
- gas-fired well-head engines would operate continually at their maximum design throughout the LOP.

In reality, well development equipment would be phased in gradually, and added or removed incrementally as actual development requirements change. These assumptions are made because the Farmington RMP does not authorize specific natural gas development; the assumptions reflect a "reasonable, but conservative" upper bound on potential air pollutant emissions and their predicted air quality impacts.

The maximum predicted cumulative $NO_2$ concentrations, atmospheric deposition and visibility impacts (including the Farmington RMP and Draft NSJB CBM EIS Alternatives 1, 2, and 5 emission sources) are presented in Table 3–203. Although most of the predicted impacts are below significance thresholds, because the ANC level at Upper Grizzly Lake is less than 25 µeq/l, the FS 1.0 µeq/l "Limit of Acceptable Change" is applicable. Therefore, based on "reasonable, but conservative" analysis assumptions, this threshold would be exceeded by the predicted impacts of 1.9 to 2.1 µeq/l. In addition, the NPS and FS visibility "Limit of Acceptable Change" of more than a single day above a 'just noticeable change' (FLAG 2000) could be exceeded between 11 to 32 days per year at the Mesa Verde National Park, and between 5 to 25 days per year at the Weminuche Wilderness PSD mandatory federal Class I areas.

**Table 3–203 Maximum Potential Cumulative Air Quality Impacts by Management Alternative (including reasonably foreseeable Colorado, New Mexico, SUIT, and Farmington RMP emission sources with well-head engines operating at a 9.6 gm/HP-hour $NO_x$ emission rate)**

| PSD Class I Area | Pollutant | Units | Alternative 1 | Alternative 2 | Alternative 5 | Impact Threshold |
|---|---|---|---|---|---|---|
| Mesa Verde | Nitrogen Dioxide | Annual (µg/m$^3$) | 0.51 | [~~0.52~~<br>0.57] | 0.49 | 2.5 |
| | Atmospheric Deposition | Total Nitrogen Deposition (kg/ha-yr) | 0.22 | 0.22 | 0.21 | 3 |
| | Visibility | Greater than 1.0 deciview (days/year) | 14 to 31 | 15 to 32 | 11 to 32 | More than 1 day/year |
| Weminuche | Nitrogen Dioxide | Annual (µg/m$^3$) | 0.27 | 0.33 | 0.21 | 2.5 |
| | Atmospheric Deposition | Total Nitrogen Deposition (kg/ha-yr) | 0.14 | 0.18 | 0.14 | 3 |
| | Upper Grizzly Lake Chemistry[1] | ANC Change (percent) | 8.1 | 8.6 | 7.6 | 10 |
| | | ANC Change (µeq/l) | 2.0 | 2.1 | 1.9 | 1.0 |
| | Visibility | Greater than 1.0 deciview (days/year) | 9 to 21 | 11 to 25 | 5 to 20 | More than 1 day/year |

Note:
1. Potential cumulative impacts at other sensitive lakes would be less.
Source: RTP Environmental 2004

Further analysis was conducted to evaluate the potential effectiveness of "state-of-the-science" emission controls on Farmington RMP natural gas-fired well-head engines operating at a 2.0 gm/HP-hour $NO_x$ emission rate. Although control equipment is available at this emission rate, the costs of such controls are higher and their performance throughout a 20 year LOP has not been evaluated. Potential maximum cumulative $NO_2$ concentrations, atmospheric deposition, and visibility impacts (including the Draft NSJB CBM EIS Alternatives 1, 2, and 5 emission sources) are presented in Table 3–204. Although most of the predicted impacts are below significance thresholds, because the ANC level at Upper Grizzly

Lake is less than 25 μeq/l, the FS 1.0 μeq/l "Limit of Acceptable Change" is applicable. Therefore, based on "reasonable, but conservative" analysis assumptions, this threshold would be exceeded by the predicted impacts of 1.1 to 1.4 μeq/l. In addition, the NPS and FS visibility "Limit of Acceptable Change" of more than a single day above a 'just noticeable change' (FLAG 2000) could be exceeded between 3 to 16 days per year at Mesa Verde National Park, and between 1 to 17 days per year at the Weminuche Wilderness PSD mandatory federal Class I areas. Finally, small well-head engines with $NO_x$ emission controls less than 2.0 gm/HP-hour would be needed on both NSJB and Farmington RMP sources to assure cumulative visibility impacts would be less than the NPS and FS visibility "Limit of Acceptable Change."

**Table 3–204 Maximum Potential Cumulative Air Quality Impacts by Management Alternative (including reasonably foreseeable Colorado, New Mexico, SUIT, and Farmington RMP emission sources with well-head engines operating at a 2.0 gm/HP-hour $NO_x$ emission rate)**

| PSD Class I Area | Pollutant | Units | Alternative 1 | Alternative 2 | Alternative 5 | Impact Threshold |
|---|---|---|---|---|---|---|
| Mesa Verde | Nitrogen Dioxide | Annual (μg/m$^3$) | 0.37 | 0.52 | 0.36 | 2.5 |
| | Atmospheric Deposition | Total Nitrogen Deposition (kg/ha-yr) | 0.15 | 0.16 | 0.15 | 3 |
| | Visibility | Greater than 1.0 deciview (days/year) | 4 to 11 | 4 to 16 | 3 to 13 | More than 1 day/year |
| Weminuche | Nitrogen Dioxide | Annual (μg/m$^3$) | 0.22 | 0.28 | 0.16 | 2.5 |
| | Atmospheric Deposition | Total Nitrogen Deposition (kg/ha-yr) | 0.10 | 0.14 | 0.10 | 3 |
| | Upper Grizzly Lake Chemistry[1] | ANC Change (percent) | 5.1 | 5.5 | 4.6 | 10 |
| | | ANC Change (μeq/l) | 1.2 | 1.3 | 1.1 | 1.0 |
| | Visibility | Greater than 1.0 deciview (days/year) | 2 to 15 | 5 to 17 | 1 to 12 | More than 1 day/year |

Note:
1. Potential cumulative impacts at other sensitive lakes would be less.
Source: RTP Environmental 2004

## 3.18.4 Mitigation and Monitoring

### 3.18.4.1 Mitigation

Roads and well locations constructed on soils susceptible to wind erosion could be appropriately surfaced to reduce the amount of fugitive dust generated by traffic or other activities, and dust inhibitors (surfacing materials, non-saline dust suppressants, water, etc.) could be used as necessary on unpaved collector, local and resource roads which present fugitive dust problems. To further reduce fugitive dust, Operators could establish and enforce speed limits (15 to 30 mph) on all project-required roads in and adjacent to the Project Area. In addition, some Operators have begun using flare-less flow-back units to capture otherwise released gas instead of flaring the gas.

In developing the emission inventory for the air quality impact assessment, it was assumed that central compression engines would have a reasonably foreseeable average $NO_x$ emission rate of 1.5 g/HP-hour during operation, which reflects recently permitted equipment using Lean-burn or Nonselective Catalytic Reduction technologies. As indicted in Table 3–205, a variety of potential emission reduction measures (BLM 1999) are available to limit $NO_x$ and other pollutant emissions. This table is not intended to rank or identify a required emission reduction measure; the appropriate level of control would be determined and required by the applicable air quality regulatory agencies during their preconstruction permit application review process. In addition, where construction and operation of central compressor stations require a land use authorization from federal land managers, specific emission control limits may be considered for inclusion in the authorization.

**Table 3–205 Potential Central Compressor Engine $NO_x$ Emission Control Measures**

| Control Measure | Percent Control | Emission Rate (g/HP-hr) | New/Retrofit | Comment |
|---|---|---|---|---|
| Lean-burn Combustion | 80 to 90 | 1.5 to 4.0 | Yes/Yes | Increase the air-to-fuel ratio to lower the peak combustion temperature, thus reducing the formation of $NO_x$. |
| Nonselective Catalytic Reduction | 80 to 90 | 1.0 to 5.0 | Yes/Limited | Installation of catalysts in the engine exhaust with sufficient VOC content (rich-burn engines). |
| Selective Catalytic Reduction | 80 to 90 | 1.0 to 2.5 | Yes/Limited | Installation of catalysts in the engine exhaust with significant oxygen content (lean-burn engines). |
| Electric Compression | 100 | 0.0 | Yes/No | Using electric compression motors could eliminate direct emissions, but increased $NO_x$ emissions would occur at generation stations (such as from coal-fired power plants) often burning dirtier fuels. |
| Fuel Cell Technology | 100 | 0.0 | Not Available | Theoretical use of fuel cells would eliminate direct emissions, but size and number of necessary fuel cells are not currently available. |

While conducting the cumulative air quality impact assessment (RTP Environmental 2004), including potential emission sources identified in the Farmington Proposed RMP and Final EIS (BLM 2003a), it was determined that potential significant adverse impacts could occur under all alternatives if small (<100 HP) well-head engines were approved for operation at a $NO_x$ emission rate of nearly 10 g/HP-hr. Under Alternative 2 (Maximum Development), these impacts were predicted to be 15 to 32 days at Mesa Verde National Park and 11 to 25 days at the Weminuche Wilderness Area above a 1.0 dv "just noticeable change" per year. However, if small well-head engines were approved for operation at a $NO_x$ emission rate of only 2.0 g/HP-hr, these Maximum Development potential impacts would be significantly reduced to 4 to 16 days at Mesa Verde National Park and 5 to 17 days at the Weminuche Wilderness Area. If both the Alternative 1 (Proposed Action) and Farmington RMP small wellhead engines were assumed to operate at the lower small well-head engine $NO_x$ emission rate of 2.0 g/HP-hr, these potential impacts are further reduced to 3 to 10 days at Mesa Verde National Park and 2 to 12 days at the Weminuche Wilderness Area.

The Federal Land Managers are considering a range of small well-head engine mitigation strategies to reduce the magnitude and extent of these predicted significant adverse air quality impacts. The following mitigation strategies are within the jurisdiction of the Federal Land Managers' authority (based on their land-use authorization authority under applicable legislation):

- Specify a fixed $NO_x$ Emission Rate for Small Well-head Engines. The Federal Land Managers would establish a specific emission rate limit on authorized equipment to minimize or prevent the predicted significant adverse cumulative air quality impacts from occurring. However, Operators could obtain site-specific approval to exceed the required emission rates if they demonstrate doing so would not cause or contribute to the predicted air quality impacts. This approach could be initiated 30 to 45 days after the FEIS is published, based on the existing Air Quality Impact Assessment (RTP Environmental 2004). This approach also provides certainty to industry, although significant adverse impacts could still happen if emission source growth occurs which is not subject to Federal Land Managers' land use authorizations (i.e.; new power plants, additional private oil and gas development, population growth, etc.) In addition, the equipment necessary to achieve these emission rates may be more expensive than the higher emitting equipment used today.

- Establish a Total $NO_x$ Emission "Level of Concern" for Small Well-head Engines. The Federal Land Managers would establish a cumulative total annual $NO_x$ emission rate "limit of concern" for all authorized equipment to minimize or prevent the predicted significant adverse cumulative air quality impacts from occurring. If the "limit of concern" was reached, re-evaluation would occur, providing timely management review and ensuring compliance with the Federal Land Managers' mandate to protect AQRVs through the applicable air quality regulatory agencies preconstruction permitting. Operators would choose their own individual equipment emission rates, as long as the cumulative total did not exceed a specified "level of concern." It would take at least six months to develop the necessary Letters of Agreement with CDPHE-APCD and NMED-AQB to implement this approach after the FEIS is published, based on the existing Air Quality Impact Assessment (RTP Environmental 2004). This approach provides flexibility to industry, although significant adverse impacts could still happen if emission source growth occurs which is not subject to Federal Land Managers' land use authorizations (i.e.; new power plants, additional private oil and gas development, population growth, etc.) Although industry has indicated in the past that they prefer this approach, it would require developing and implementing an extensive inventory, analysis and tracking system by the Federal Land Managers. In addition, companies which develop later in the process would be under more pressure to have lower emission rates than those who develop earlier in the process.

- Establish an Adaptive Management Plan and Workgroup. Modeled after the 1994 Northwest Forest Plan, the San Juan Basin would be designated an "Adaptive Management Area" where "the development and testing of technical and social approaches to achieving desired ecological, economic and other social objectives" (including air quality) is encouraged. It would probably take at least one year to initiate this approach after the FEIS is published, with the existing Air Quality Impact Assessment Technical Support Document (RTP Environmental 2004) as a starting point. This approach provides flexibility to state air quality regulatory and federal land management agencies, but ultimate requirements would be uncertain to industry. Since the process would adapt continually, significant adverse impacts would be prevented even if additional emission source growth happens which was not addressed in the FEIS (i.e.; new power plants, additional private oil and gas development, population growth, etc.) However, an Adaptive Management approach has not been applied previously to address anticipated air quality issues. Presumably, an interagency team would be assembled to develop a process for continual evaluation of alternative air pollutant emission rates (including, perhaps, the reduction of current emissions as off-sets to additional future emissions), in order to preclude the predicted significant adverse cumulative air quality impacts from occurring.

- Establish an Air Quality Interagency Work Group. Modeled after the current NMED-AQD Ozone Task Force, the applicable air quality regulatory agencies (NMED-AQB and CDPHE-APCD) would establish a "stakeholders" based organization to further analyze and establish procedures for future regional industrial development (including, but broader than natural gas development alone) in order to prevent the predicted significant adverse cumulative air quality impacts from occurring. It is likely to take six months to develop and establish a regional Interagency Work Group after the FEIS is published, with the existing Air Quality Impact Assessment Technical Support Document (RTP Environmental 2004) as a starting point. In addition, it would probably take at least one year for this new Interagency Work Group to design, conduct, and implement its program. This approach provides flexibility to state air quality regulatory and federal land management agencies, but ultimate requirements would be uncertain to industry. Since the process could address a broader area than the existing air quality impact analysis, significant adverse impacts would be prevented even if emission source growth happens which was not addressed in the FEIS (i.e.; a larger analysis region, new power plants and central compressor stations, additional private oil and gas development, population growth, etc.)

- No Additional $NO_x$ Emission Controls for Small Well-head Engines. EPA has established existing requirements to prevent significant adverse AQRV (including visibility and atmospheric deposition) impacts from occurring. This includes development of an extensive Regional Haze Program to assure achieving the National Visibility Goal for "... the prevention of any future and the remedying of any existing impairment of visibility in mandatory class I Federal areas." EPA's oversight of local, state and tribal air quality regulatory agency implementation of these programs should prevent the predicted significant adverse impacts from actually occurring.

The Federal Land Managers discussed these alternative mitigation strategies with state (CDPHE-APCD and NMED-AQB) and federal (EPA Regions 8 and 6) air quality management agencies, and propose to implement a combination of measures. However, the selection of a specific mitigation strategy would not take place until the NEPA analysis and disclosure process is completed, and a formal Record of Decision is issued. The Federal Land Managers encourage public, organization and agency comments on the following proposed mitigation measures to limit the predicted significant adverse impacts from occurring in Mesa Verde National Park and the Weminuche Wilderness federal mandatory PSD Class I areas:

- A formal Interagency Task Force be established by the NMED-AQB to expand both the analysis area (to include a larger portion of the Four Corners Region) and topics (such as emission source growth beyond oil and gas development alone, potential ozone impacts, PSD increment issues, expanded coal-fired power plant development, etc.) The Task Force could include participation by: CDPHE-APCD; tribal governments; the Federal Land Managers; EPA Regions 6, 8 and 9; environmental organizations; industry; and other stakeholder groups, and would be funded jointly by the participants. Enforcement authority would rest with the applicable air quality regulatory agencies.
- Since it could take six months to create a formal Interagency Task Force, and several months thereafter for the Task Force to identify specific mitigation measures, the Federal Land Managers would establish a fixed $NO_x$ emission rate for small well-head engines to be effective as individual well authorizations are approved. Although the specific emission rate would not be determined until a Record of Decision is issued, the Federal Land Managers are currently considering a mandatory $NO_x$ emission limit of 2.0 g/HP-hr for all new and replacement small well-head engines subject to their approval. The emission limit would remain in effect until the Task Force determines that alternative mitigation measures are necessary. Therefore, if the Task Force is unable to develop specific measures, the interim requirement would apply throughout the LOP. Enforcement authority would rest with the applicable Federal Land Management agencies.

The following “mitigation measures” are outside the jurisdiction of the Federal Land Mangers’ authority:

- Suspend Future Development Until Air Quality Issues Are Resolved. Previous NEPA document comments have suggested “reconsider future development after more information is gathered.” Federal Land Managers can deny an individual “Application for Permit to Drill” only under very specific legal conditions. However, the applicable air quality regulatory agencies could review potential air pollutant emission sources and issue any applicable emission permits prior to construction and operation. Without this regulatory approval, the natural gas leases can not be developed.

- Withdraw or Prohibit Future Leasing. Previous NEPA document comments have suggested "withdraw or don't offer leases," apparently to eliminate natural gas development and the related air pollutant emissions. However, once a valid mineral lease has been issued, it may be conditioned, but not revoked. Similarly, under current federal mineral law, future leasing can be prohibited only in specific legal circumstances. The U.S. Congress could revise these laws, but the prospect of securing passage of such legislation and appropriation of funds for that specific purpose is extremely remote. In addition, elimination of natural gas leasing is inconsistent with Congressional direction (through the CAA) for development and promotion of alternative clean fuels needed to improve air quality nationally.

- $NO_x$ Emissions "Cap and Trade". Previous NEPA document comments have suggested "consider $NO_x$ emissions trading," therefore limiting $NO_x$ emissions at current levels. Existing $NO_x$ emission facilities could then either keep, trade or sell their emission allocations (essentially a property right to pollute) to other groups seeking to increase their $NO_x$ emissions. When coupled with "banking" (holding, but not using credits) and "discounting" (reduced emission credit values with each "trade"), overall $NO_x$ emissions would decrease. Under the CAA, the U.S. Congress has established an "allowance program" for certain $SO_2$ emitting facilities, and Congress could establish a similar $NO_x$ trading program to be implemented by the applicable air quality regulatory agencies.

- Phased (Staged) Development. Previous NEPA document comments have suggested "reduce the intensity of natural gas development," such as limiting the "... number of wells or ... amount of emissions until reach[ing] 0.5 deciview..." The Federal Land Managers do not have the authority to require that development of existing leases be limited when specified emissions levels are reached. However, as described above, an overall air pollutant emissions "level of concern" could be established at a point where re-evaluation would occur, providing timely management review and ensuring compliance with the Federal Land Managers' mandate to protect AQRVs through participation in the applicable air quality regulatory agencies preconstruction permitting process.

### 3.18.4.2 Monitoring

The Federal Land Managers could continue to cooperate with existing atmospheric deposition and visibility impact monitoring programs. The need for, and the design of, additional monitoring could include the involvement of the EPA Region 8 Federal Leadership Forum and applicable air quality regulatory agencies. Based upon future recommendations, operators could be required to cooperate in the implementation of a coordinated air quality monitoring program. Oil and gas lease terms (Section 6) require the lessee, within the lease rights granted, to take measures deemed necessary by the lessor for the conduct of operations in a manner that minimizes adverse impacts to air quality, as well as other resources.

If additional mitigation processes and measures are required in the ROD, the Federal Land Managers must ensure that implementing these measures is monitored and enforced. For example, if operators are required to ensure small wellhead engines emit less than a specific $NO_x$ emission rate, the Federal Land Managers must verify the face-plate engine power rating (taking into account average engine use, such as engine speed or hours of operation) as well as the manufacturers' guaranteed life-of-operations emission rating. In addition, if the Federal Land Managers have reason to believe required mitigation measures are not being met, then additional monitoring (such as combustion stack testing) and/or enforcement action (such as stopping operations) may be necessary.

Additional air quality monitoring may also be necessary. For example, in the Air Quality Impact Assessment Technical Support Document (RTP Environmental 2004), potential cumulative visibility impacts at Mesa Verde National Park and the Weminuche Wilderness Area were based on the FLAG Refined Daily impact analysis methodology. However, daily background visibility conditions were derived from IMPROVE speciated particulate matter sampling at each of these areas. Recent peer-reviewed scientific literature (Ashbaugh and Eldred 2004) has questioned the validity of IMPROVE sampling and analysis procedures for secondary ammonium nitrate particulate matter (possibly underestimating the background visibility conditions). An underestimate of background visibility could lead to an overestimate of potential visibility impacts from proposed $NO_x$ emission sources. Therefore, direct optical monitoring in Mesa Verde National Park and/or Weminuche Wilderness Area (using a transmissometer or nephelometer) may be required to establish background conditions and future trends, regardless of impacting chemical/physical constituents. The Federal Land Managers may require that additional air quality monitoring be funded by the Operators.

## 3.18.5 Conformance to Existing Plans and Policies

Both the federal CAA and FLPMA require all federal activities (whether conducted directly, or approved through use authorizations) to comply with all applicable local, state, tribal and federal air quality law, statutes, regulations, standards and implementation plans. Potential CBM development under the proposed action and alternatives would conform to these requirements, consistent with existing land use plans.

## 3.18.6 Unavoidable Adverse Effects

Some decrease in air quality would occur through implementation of the proposed action or alternatives; however, based on the "reasonable, but conservative" modeling assumptions, these direct impacts are predicted to be below applicable significance thresholds.

## 3.18.7 Irreversible and Irretrievable Effects

Once disturbed lands are re-vegetated, potential air quality impacts from CBM development would cease after the life of the project. Therefore, there would be no irreversible or irretrievable effects on air quality.

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